# WHITE PINE BLISTER RUST CONTROL

## Annual Report
## Calendar Year 1963

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
REGION ONE

MISSOULA, MONTANA

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UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

REGION 1

Missoula, Montana
March 1, 1964

# WHITE PINE BLISTER RUST CONTROL ANNUAL REPORT

Calendar Year 1963

This report was prepared under the direction of E. H. Juntunen, Chief, Division of State and Private Forestry, by H. J. Hartman, Chief, Forest Pest Control Branch, and David A. Graham, Head, Blister Rust Control Section, from information furnished by and from the following:

John P. Bushfield - Staff Officer, Clearwater National Forest
Daniel K. Chisholm - Forester, Clearwater National Forest
Harry J. Faulkner - Staff Officer, Coeur d'Alene National Forest
Andy O. Fossum - Forestry Aid (TM), Coeur d'Alene National Forest
Quentin W. Larson - Project Officer, Kaniksu National Forest
Dwayne T. Brigham - Forester, Kaniksu National Forest
Frank J. Kapel - Forester, Kootenai National Forest
Harold D. Ingrum - Forestry Aid (TM), Kootenai National Forest
Clyde J. Miller - Staff Officer, St. Joe National Forest
Oliver K. Goldammer - Forest Technician, St. Joe National Forest
Virgil D. Moss - Chief, Methods Development and Improvement Branch, Spokane, Washington
Wayne E. Bousfield - Forester, Methods Development and Improvement Branch, Spokane, Washington
Donald H. Brown - Forester, Methods Development and Improvement Branch, Spokane, Washington
John C. Gynn - Forester, Blister Rust Control, Midwest Region, National Park Service
John F. Breakey - Blister Rust Control Equipment Specialist, Spokane, Washington
Richard T. Bingham - Project Leader, Rust Resistant White Pine Development, Intermountain Forest and Range Experiment Station, Forestry Sciences Laboratory, Moscow, Idaho

The following agencies are conducting or are actively cooperating in white pine blister rust control:

U.S. Forest Service
National Park Service
State of Idaho
Clearwater Timber Protective Association
Potlatch Timber Protective Association
Priest Lake Timber Protective Association
Bureau of Land Management
University of Idaho

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# I. HIGHLIGHTS OF 1963 BLISTER RUST CONTROL PROGRAM

## THE OVERALL BLISTER RUST CONTROL PROGRAM

### General

A greater acreage of white pine was treated in 1963 for blister rust control than in any of the past 24 years.

Total National Forest and State and Private control program accomplishment on lands of all ownerships was 122,020 acres. In addition, the National Park control program accomplishment was 17,880 acres.

The National Forest and State and Private control program included some 11,350 acres of immature western white pine treated with antibiotics by the basal stem method, requiring 7,670 man-days or .68 man-days per acre. Phytoactin L-318 was applied as a foliar spray by helicopters on 100,600 acres of immature western white pine, requiring 1,888 flying hours. An additional 93 flying hours were used in making operational surveys. Blister rust control crews eradicated ribes on 10,070 acres, requiring 9,620 man-days or .96 man-days per acre.

The National Park program included 3,790 acres treated with antibiotics by the basal stem method, requiring 1,320 man-days or .35 man-days per acre, and ribes eradication on 14,090 acres, requiring 3,900 man-days or .28 man-days per acre.

At the present rate of progress, all of the 717,000 acres of immature western white pine on National Forest lands will have been treated with antibiotics in 1967. The 352,000 acres of immature western white pine on state and private lands will not be completely treated until 1979.

### Integrated Control Methods

The following selective methods of white pine blister rust control are being practiced and developed:

1. Control by ribes eradication in selected stands under 10 years of age, or within areas specifically harvest-cut for western white pine regeneration.

2. Control by applying antifungal antibiotics to selected stands 10 to 100 years of age. The objective is to kill present rust infections and immunize for a period of time all treated white pine against future blister rust infections. Most of this application is done aerially with helicopters. Basal stem treatment is generally limited to stands 10 to 20 years of age, or stands otherwise not suited for aerial treatment.

3. Nursery stock immunization by applying antibiotics to all white pine seedlings in the nursery prior to outplanting.

By the year 2000, white pine blister rust will have destroyed most all unprotected limber and whitebark pine stands in this Region. These species have little commercial value, but by occupying an ecological niche unsuited to any other tree species, they have a significant affect on watershed and esthetic values.

Antibiotic Treatment of Mature Stands

While the 1961 aerial treatment tests in mature stands showed very heavy biological action in 1963, there was no positive evidence that the large infections on the tree boles were inactive. The biological action on most all blister rust infections resulted in very heavy top and branch flagging. Although this hastening of top and branch flagging appears alarming, it would have occurred a few years hence even though the stand had not been treated. Antibiotic treatment of mature western white pine stands cannot yet be recommended. Observation of results will continue in 1964, and additional test plots will be established.

Antibiotic Persistence

The exact period of white pine blister rust infection immunity that will result from a single application of an antibiotic is not known. New infection has not been detected in any areas properly treated with antibiotics in this Region. While it is now evident that antibiotics remain biologically active in properly treated trees for a period of years, the antibiotic persistence level required to prevent new blister rust pine infection is not known. Artificial inoculation and bioassay studies aimed at determining these answers are being conducted.

Spread of the Rust

Intensive scouting for new white pine blister rust infections outside of the known limits of the rust was not conducted in 1963. However, Intermountain Forest and Range Experiment Station personnel found white pine blister rust infection on limber pine in the extreme southeastern corner of Idaho on the Cache National Forest. This represents a 75-mile southern extension of known pine infection in that region. A greatly increased number of blister rust infected ribes were reported in the vicinity of Jackson, Wyoming, although no new pine infection was observed. All indications are that a heavy pine infection center will soon develop in Grand Teton National Park.

Blister rust infection on ribes in the western white pine belt was moderate to light throughout most of the type.

It is now evident that 1959 was a moderately heavy pine infection wave-year. Light to moderate pine infection of 1959 origin was observed this year in many unprotected stands. One contributing factor was the heavy September 1959 precipitation, which amounted to 9.21 inches at Headquarters, Idaho, and 7.79 inches at Elk River, Idaho. Normal September precipitation for these locations is 2.54 and 1.72 inches respectively.

Antibiotic Side Effects

No harmful side effects have been associated with the treating of 330,000 acres with antibiotics. No detectable damage has occurred to fish, wildlife, beneficial insects or fungi.

## CLEARWATER NATIONAL FOREST AND CLEARWATER TIMBER PROTECTIVE ASSOCIATION

White pine blister rust control on National Forest lands was accomplished mainly by ribes eradication and antibiotic aerial treatment. Ribes eradication was confined to those areas that had been recently prepared for white pine regeneration. Some immature state and private white pine stands that could not be aerially sprayed were treated with antibiotics by hand.

Seven base camps were established in 1963 within the Independence, Sheep Mountain, Orofino Creek, Musselshell, Alder Creek, Deer Creek and Hildebrand Creek white pine management units.

Five spike camps were established for crews engaged in aerial application of antibiotics. Aerial treatment with antibiotics was continued in white pine pole stands on state, private, and Federal land within the Hildebrand, French, Orofino, Rosebud, Washington, Musselshell, Cedar, Chamook, Lolo-Nevada, Gold, Dollar, and Siberia Creek white pine management units.

Not all the 1963 objectives were attained, as weather conditions and a late season fire reduced available fall spraying time. Plans called for aerial application of antibiotics to 9,000 acres in the fall program, but only approximately 4,000 acres were treated. Unusually high temperatures, accompanied by light winds in September greatly reduced effective spray periods. The first full week of October was lost when both helicopters and the service crew were called for fire duty.

Nearly 15 percent of the total man-days available for project work was spent on firefighting assignments this season. This is considerably more time lost to fires than the previous year but does not compare with the 1961 season when 40 percent was lost to firefighting activities.

Field work of the five camps established on National Forest lands concentrated on ribes eradication with power spray equipment in controlled-burn areas within the Alder, China, Orofino, and Musselshell Creek units. Hand ribes eradication was also continued in these units and was completed in the protection zones for the Sheep Mountain and Laundry Creek units. Extended ribes seed germination in the Sheep Mountain unit will necessitate some rework to prevent infection of the new crop of white pine.

The two camps established on state and private lands were engaged in hand application of antibiotics to young white pine in the Hildebrand, Deer, and Reeds Creek units. This is a continuation of the plan to hand treat all reproduction within approved management units that cannot be treated aerially because of overstory. At the present rate of financing it will require two more seasons to complete this initial treatment.

Basal stem treatment, Clearwater National Forest.

Log landing near Pierce in center of western white pine production area, Clearwater National Forest.

The completion of the Kamiah Ranger Station at Kamiah and subsequent move of the Pierce Ranger District headquarters to Kamiah enabled the blister rust project to acquire much needed office and vehicle storage space at the Pierce administrative site. This is the first time since the inception of the BRC program that all project equipment and supplies have been stored in one location.

Dr. James W. Kimmey of Forest Sciences Laboratory at Moscow, Idaho, installed two antibiotic experimental plots on private lands within management units this season. One series of plots will test hand antibiotics application and one will test aerial antibiotics application. Some 114 man-days of time were contributed in assisting in such things as boundary marking, tree marking, and tree treatment on these plots. The aerial spray plots were selected, marked and made ready for spraying but were not sprayed because of weather conditions. These aerial plots will be treated in the spring of 1964.

Survey work was completed on approximately 62,000 acres in 1963. Included in this acreage are ribes population checks, antibiotic effectiveness evaluations and surveys of stands to determine antibiotic treatment potential.

An additional 300 acres within white pine management areas were control-burned and prepared for planting. Because of good burning conditions this site preparation was very satisfactory.

Two trailer houses were constructed during the spring for use by the aerial spray crew. This kitchen and bunkhouse unit proved to be very timesaving and made moves between helispots much more efficient. It requires one-half hour to load the trailer units and ready the camp for a move to a new location. This can be accomplished by the spray crew and requires no outside help.

The project had a total of 12 reportable accidents of which four were lost time.

Staff Assistant Ted E. Leach was transferred to the Kelly Creek Ranger District in June and was replaced in August by Daniel K. Chisholm from the Nezperce National Forest.

## COEUR D'ALENE NATIONAL FOREST

The continued expansion of aerial application of antibiotics in 1963 resulted in the largest acreage treated for control of white pine blister rust since the beginning of the program in 1927. Some 31,380 acres were treated by all methods, including 28,820 acres of aerial treatment, 800 acres of basal stem treatment, and 1,760 acres of hand and chemical ribes eradication. A total of 61,720 acres have been treated with antibiotics to date.

Eighty workers were employed on all phases of blister rust control work. Crews were stationed at the Hudlow Work Center, Trail Work Center, Shoshone Work Center, and Potter Creek Blister Rust Control Camp. Hand and chemical ribes eradication was performed on prescribed-burn areas in the Hudlow, Potter, and Yellow Dog white pine management units. Antibiotics were applied by basal stem method to selected small areas of reproduction and pole white pine not suitable for aerial treatment in the Hudlow and Burnt Cabin units.

## KANIKSU AND COLVILLE NATIONAL FORESTS AND PRIEST LAKE TIMBER PROTECTIVE ASSOCIATION

Control of white pine blister rust on the Kaniksu and Colville National Forests and the Priest Lake Timber Protective Association during 1963 was accomplished mainly by basal stem or aerial application of antibiotics. Since use of antibiotics began in 1956, a total of 71,330 acres of high-value, immature white pine have been treated.

Total number of men employed in the organization remained about the same as in 1962. During the peak of the season 100 men were employed. A 10-man ribes eradication camp was located in the Goose Creek drainage on the Falls District. Four crews, including one working from the main headquarters at Kalispel Bay and a local crew commuting from the town of Priest River, were used for basal stem application of antibiotics. A 30-man camp was located on Upper Lamb Creek on the Priest Lake District, and on the Colville National Forest a 10-man crew hand treated a 540-acre western white pine plantation at Tiger Hill.

Aerial application of Phytoactin was accomplished on 26,860 acres in 1963. This is the largest single year total sprayed to date on this Forest. Two units, with two helicopters each, sprayed white pine areas on the Priest Lake and Falls Districts during April, May, and June. Fall spraying was done on the Trout Creek and Falls Districts during September and early October. All planned acreage was sprayed.

Twelve of the most experienced men were used during the summer on surveys. The surveys included efficiency and status checking of ribes eradication areas, evaluation of antibiotics effectiveness, and intensive and extensive blister rust damage surveys. On the Newport District a helicopter was used to inspect and determine white pine aerial spray boundaries on 40,000 acres. Fourteen thousand acres were also inspected and mapped on the Priest Lake Timber Protective Association.

A crew worked from early June through the early part of December on helispot construction. Twenty-five new helispots were constructed; 19 on the Kaniksu Forest, 3 on the Colville Forest, and 3 on the Association. Since 1960, a total of 46 helispots have been constructed for aerial spray work. All ground disturbed at helispot sites has been seeded to grass and fertilized.

Very little project worktime was lost to fire suppression activities during the year. One 60-man crew was dispatched to the Little Granite Creek fire on the Nezperce National Forest and several small crews were used to fight fire on the local districts.

Rain and heavy dew continued to cause lost production for the antibiotic hand treatment crews. Brief rainstorms occurred often during the months of July and August causing considerable lost worktime. Early morning dew caused some problems and made it necessary to reschedule the workdays during the month of August.

Cone on young tree in the rust resistant white pine seed orchard at Sandpoint. Scionwood, obtained from a cone producing age tree, was grafted to stock outplant in 1960. Trees similar to the one pictured above are expected to produce one to three cones next year, Kaniksu National Forest.

The rust resistant white pine seed orchard at Sandpoint, established in 1960, is producing cones. The first viable seed was collected this year. Examination of the orchard shows that many of the young trees will produce cones in 1964.

Noxious weeds and hardwood saplings in and around the seed orchard were destroyed and a drainage system installed. The trees are now large enough to be visible from the highway near the area and are attracting many visitors.

The new combined Priest Lake Ranger Station and blister rust control headquarters is being constructed with funds from the Accelerated Public Works Program. The office, a residence, and a shop will be completed early in 1964.

Despite increased emphasis placed on safety training and practices the project had several accidents during the season. A Blister Rust Control Safety Committee was organized, with a representative from each camp, which established and administered contests between crews and individuals. Awards were given for safe work performance. Our plans for 1964 include increased emphasis on safe work practices for each individual blister rust control employee.

Leonard Easley, a longtime camp superintendent on the Forest, retired in March. Another Camp Superintendent, Richard Peterson, was transferred and promoted to fire control officer on the Noxon District.

## KOOTENAI NATIONAL FOREST

Blister rust control work during the 1963 season was limited to the application of antibiotics. No ribes eradication work was done. The 14 workers employed, basal-stem treated some 400 acres of young white pine in the South Fork Callahan drainage. Aerial treatment was completed on 7,650 acres of pole-size white pine in the West Fork Quartz, Spread, Yaak Face, and Burnt Creek units.

Weather conditions were generally unfavorable for hand spraying during a large portion of the summer. Considerable rain fell during June. Heavy dew during July and August kept tree boles wet until almost midday on some days. Weather was not a problem during the aerial spray project in the fall and the job was completed on schedule.

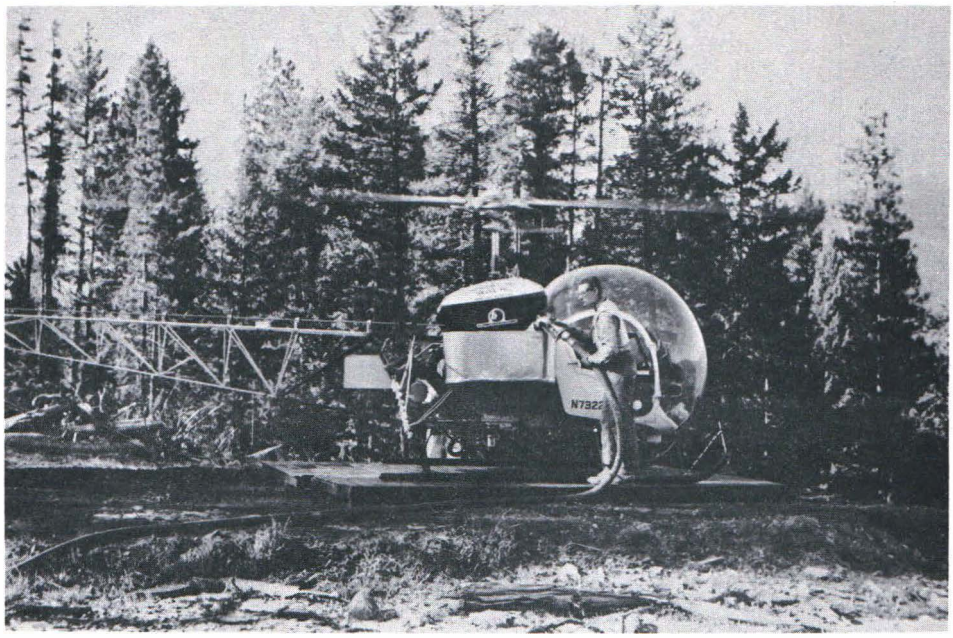
A total of 120 man-days were spent on fires. Of this total, 90 were effective man-days that would have been available for field work. A total of 159 effective man-days were lost because of wet weather conditions. Time lost to fire and weather represents 31 percent of the total time that would otherwise have been available for basal stem treatment.

Several basal stem test plots were established during the summer as follows:

1. Acti-dione BR current formulation with scarification.

2. Phytoactin L-440 with scarification, boles wet.

3. Phytoactin L-440 with scarification, boles dry.



Crewman loading G-3B helicopter with antibiotic solution (Phytoactin), Quartz Creek heliport, Kootenai National Forest.

G-3Bl and G-3B helicopters arriving at the Quartz Creek heliport to reload with antibiotic (Phytoactin), Kootenai National Forest.

4. Phytoactin L-440 without scarification, boles wet.

5. Phytoactin L-440 without scarification, boles dry.

6. A 10-acre block in the Star Creek unit was retreated with Phytoactin L-440 and Acti-dione BR in separate tests. A light cycle oil with an aniline point of 96° F. was used as the carrier in both formulations.

Survey work was limited to establishing permanently marked trees for evaluating the effectiveness of antibiotics in areas treated during 1963 and evaluating treatment results of prior years.

The operation completed another season without a lost-time accident. This makes a total of 235,168 man-hours worked since the last lost-time accident on July 5, 1951.

## ST. JOE NATIONAL FOREST AND POTLATCH TIMBER PROTECTIVE ASSOCIATION

There were 120 workers employed on blister rust control during 1963. Eighty employees were stationed in field camps located at West Fork Charlie Creek, Clarkia Ranger Station, and Feather Creek. These workers hand treated immature white pine with the antibiotic Acti-dione on 4,200 acres of Federal, 1,030 acres of state, and 460 acres of private land.

One 40-man state and private camp was stationed on the East Fork Potlatch Creek near the mouth of Bobs Creek. This unit eradicated ribes from 1,900 acres in the East Fork Potlatch drainage near Badger Meadows. The removal of ribes from this recently cutover land, where white pine regeneration is planned, is necessary to protect white pine seedlings from blister rust until the trees are large enough for effective antibiotic treatment.

The initial hand spraying of most immature white pine stands, suitable for basal stem antibiotic treatment, was completed within the St. Joe approved National Forest and state and private white pine management units during 1963.

Future basal stem antibiotic spraying will be mostly limited to the retreatment of immature white pine stands where initial hand spraying was not satisfactory. All live cankers will be scarified when retreated. Scarifying the canker margin will allow better penetration of the antibiotic and improve treatment effectiveness. Some recently established white pine stands will need to be initially treated with antibiotics as soon as they become large enough for effective treatment.

Helicopters sprayed the antibiotic Phytoactin on 24,450 acres of Federal, 1,880 acres of state, and 450 acres of private white pine pole stands during 1963. White pine stands were treated during April through June in the North Fork Palouse, South Fork Palouse, Big Sand, Little Sand, and Strychnine units.

by two helicopters stationed at the mouth of White Pine Gulch on the North Fork Palouse River. Two helicopters located at Clarkia treated white pine in the Cedar-Blair, West Fork Merry Creek, Clarkia, Keeler, Anthony, and Flewsie-Gramp Creek units during May. The remaining untreated white pine pole stands in the North Fork St. Joe River and the Loop Creek drainage were aerially sprayed in September with two helicopters.

The St. Joe blister rust control project supervised and conducted the aerial application of Phytoactin to 160 acres of white pine pole near the mouth of Merry Creek, owned by Potlatch Forests, Inc. A helicopter based at Clarkia, Idaho, sprayed the area during May 1963. Fifty percent of the cost of treating this private land was paid by Potlatch Forests, Inc., under a special cooperative agreement. Federal funds were used to match the private contribution, as authorized by the Lea Act of April 26, 1940.

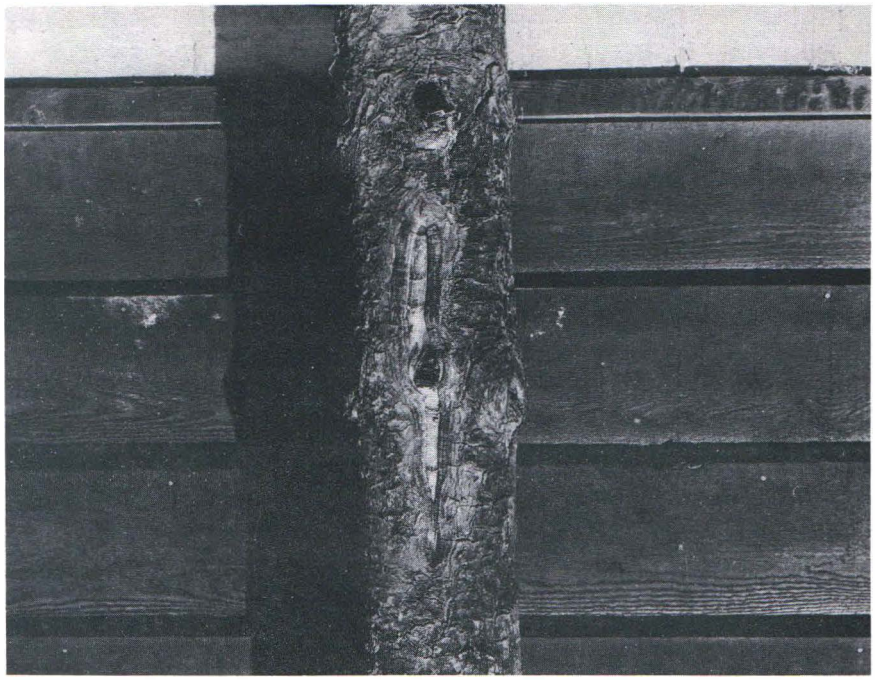
Weather conditions favored blister rust control field activities again this season. The summer was generally cool and dry. Although the St. Joe Forest controlled a record number of fires this season (259), only 450 effective control man-days were lost to fire suppression work. The blister rust control organization spent a total of 890 man-days on fire suppression work, standby, and training, including overtime and weekend work.

Antibiotic treatment evaluation crews have systematically established 2,116 study trees in both basal stem and aerially treated white pine stands. The study trees have been well marked and all stem cankers on sample trees have been marked, measured, and recorded to provide for effective future evaluations. Household pins have been used to mark the canker margins. Pins will be placed on canker margins during subsequent inspections to show canker growth, or lack of growth.

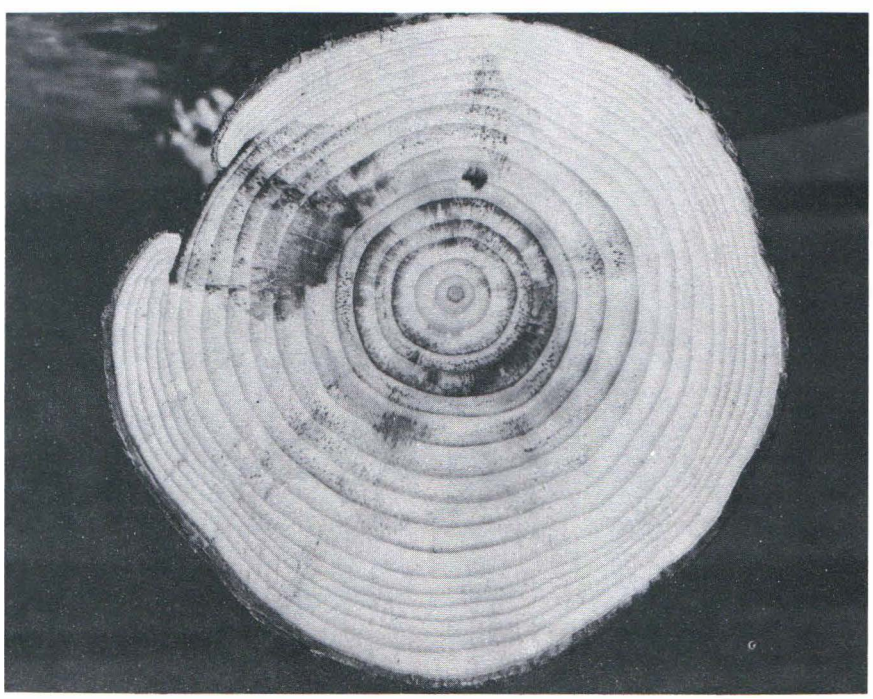
The blister rust control organization has been coordinating white pine antibiotic treatment work with timber stand improvement projects. Foresters marked the "leave" white pine stems on several hundred acres of plantation in the Charlie Creek drainage during the fall and winter of 1962-1963. Blister rust control crewmen treated the "leave" trees with antibiotics during the summer of 1963. The thinning work was done after crews had finished treating the marked stems. The marking-treating-thinning sequence on white pine thinning projects is preferred, as only crop trees are treated and treating crews can move through the stand without being hindered by thinning slash.

The planned blister rust control program for 1964 includes a 30-man ribes eradication camp in the East Fork Potlatch Creek drainage to continue control work in newly established white pine stands where the mature overstory has been recently removed. Aerial antibiotic treatment is planned in the white pine pole stands on the Palouse River near Laird Park, Jerome-Big Creek, West Fork Potlatch, Moose Creek, and Corral Creek areas during the spring and fall of 1964.

The St. Joe blister rust control safety program was again very effective in 1963. The project had only one medical case which resulted in 4.5 lost workdays because of an employee's allergy to the basal stem antibiotic solution. Good first aid treatment by the camp superintendents effectively prevented infection in cuts, lacerations, abrasions, and blisters, and kept minor injuries from becoming medical cases.



Blister rust canker on a 4" d.b.h. white pine tree showing how healing progresses 5 years after treatment with Acti-dione, St. Joe National Forest.



Transverse section view through above canker showing growth rings and healing of canker area after infection was killed by Acti-dione treatment in 1958. Tree was cut in late August 1963, St. Joe National Forest.

## NATIONAL PARK SERVICE

## MIDWEST REGION

The 1963 white pine blister rust control program was conducted as provided by the Lea Act and the 1961 agreement between the U.S. Departments of Interior and Agriculture. The National Park Service assumed complete responsibility for operational activities and coordination between Parks. The Forest Service furnished interagency leadership and gave assistance in accord with the agreement between the two agencies.

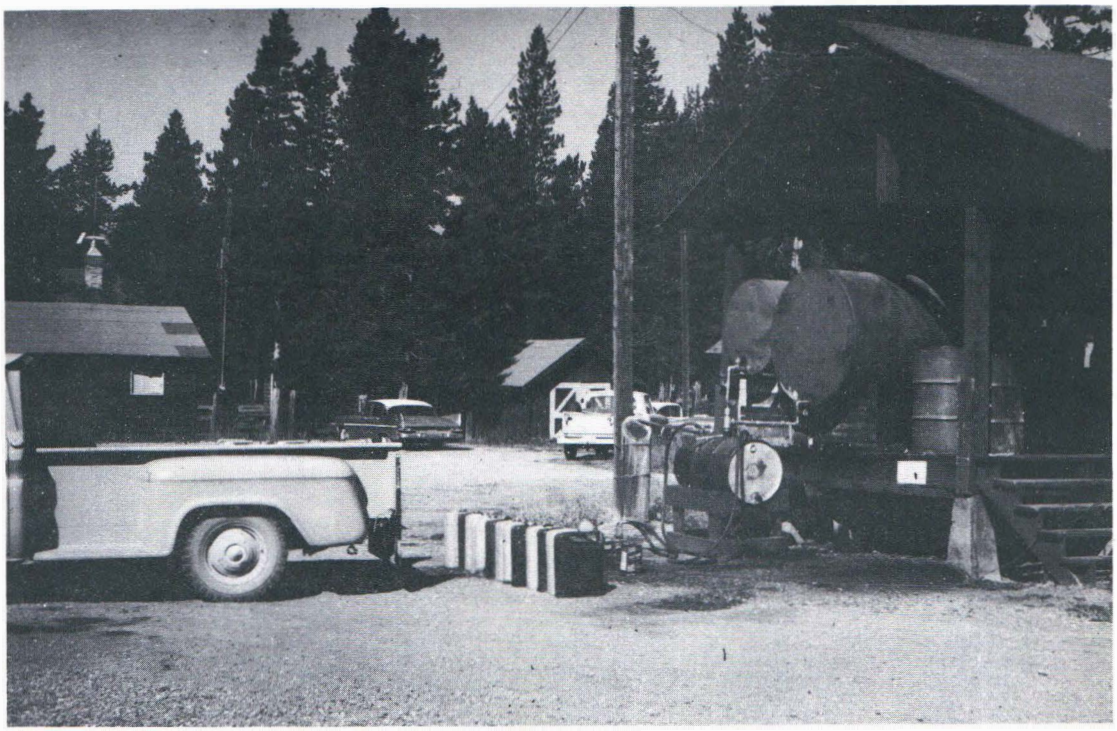
### Personnel Participating

| | |
|---|---|
| Glacier | C. Donald Barnum, Supervisory Park Ranger in Charge (until May 1, 1963)<br>Charles A. Budge, Supervisory Park Ranger in Charge (after May 1, 1963) |
| Yellowstone | Marion W. Myers, Park Forester in Charge<br>John N. Reeves, Forestry Technician, Project Supervisor |
| Rocky Mountain | Robert K. Weldon, Park Forester in Charge |
| Regional Program | John C. Gynn, Forester (TM) in Charge<br>Maynard B. Barrows, Forester, Consultant |
| U.S. Forest Service, Northern Region | David A. Graham, Section Head, White Pine Blister Rust Control |

### Glacier National Park

The tentative boundaries of all areas, designated as antibiotic "treatable acres," outside of ribes eradication control units were adjusted to conform with actual treatment limits. Some 3,100 acres were eliminated because of inaccessibility, age class, amount of white pine present, and/or advancement of the disease. All acres within ribes eradication control units have now been classified as "treatable acres" to adjust with Forest Service reporting procedures.

The 1963 program was confined to the antibiotic treatment of white pine. No ribes eradication work was performed. The antibiotic Phytoactin L-440 at 200 p.p.m. in No. 1 fuel oil, with a small amount of surfactant Triton B-1956 added as a safety factor against possible crystallization, was used for treating all species of white pine. The spray solution was mixed with an electrically-driven ECO circulating pump. A light portable gasoline-driven ECO pump was used for mixing where electricity was not available. Beginning about July 22 a new type scarifier spray nozzle developed by the Branch of Methods Development and Improvement, Forest Service, became available and was



Antibiotic mixing plant at the East Glacier Ranger Station, Glacier National Park.

Mule string packing antibiotic spray solution from Two Medicine Ranger Station to Oldman Lake, Glacier National Park.

used on all units. Purpose of the scarifier addition was to puncture the smooth bark around canker perimeters and increase penetration of the antibiotic. The standard basal stem method of spray application was used.

West of the Continental Divide a crew of 35 men treated 164,000 western white pine on 2,310 acres. The North Fork Road, West Shore of Lake McDonald, Avalanche Trail, and Mineral Creek units were completed. Finishing the Coal Creek area in 1964 will complete all western white pine areas approved for treatment to date. A small amount of retreatment may be necessary where treatment was performed prior to improved formulations, methods, and/or spraying techniques. Inspections show that effectiveness has increased each year following treatment, i.e., in areas treated in 1960 canker mortality was continuing in 1963. As in 1962, inclement weather interfered with work progress to a considerable degree.

East of the Continental Divide working goals were exceeded. The Oldman Lake unit was completed as scheduled and 200 additional acres outside, but immediately adjacent to the control unit were treated. A crew of 11 men treated 198,000 sapling- to pole-size whitebark pines on 1,480 acres. A high standard of camp management and field work efficiency was maintained throughout the summer.

## Yellowstone National Park

To cope with the transition from eradicating large ribes concentrations on steep mountain slopes and swampy stream type strips, to eradicating lightly scattered ribes and small widely dispersed concentrations, the field organization was changed. The use of large crews was eliminated. After intensive training, men were carefully selected as to their aptitude in the various ribes eradication methods, efficiency and working speed, and then organized into small highly mobile crews. Checkers and foremen were trained to expedite progress of the work by demanding a high standard of efficiency and coordinating the various methods of ribes eradication.

All 1963 objectives were achieved or excelled. Initial ribes eradication was performed on 10,160 acres. An additional 2,180 acres were reworked and 690 acres maintained as scheduled. A control status examination resulted in 8,630 acres in the unworked and rework categories being placed on a maintenance basis.

To give added protection to the Mammoth limber pine unit, heavy masses of Ribes petiolare (a highly susceptible species) were eradicated from 40 acres in the badly infected Glen Creek area. The area freed of ribes is outside of the control unit boundaries, but represented a potential source of pine infection within the Mammoth unit.

## Rocky Mountain National Park

Approval of the revised regional program permitted starting initial ribes eradication in the Hidden Valley control unit. In 1956, when the unit was first surveyed and a ribes eradication working plan prepared, it was recognized that the heavy masses of ribes in the stream type, blowdown, and ski

runs made the central portion of Hidden Valley the most favorable for inception of the disease. Work schedules were planned accordingly. Since 1956, heavy ribes populations have developed in newly disturbed areas. This occurrence has increased the number of acres originally designated for chemical ribes eradication.

Initial ribes eradication was performed on 1,060 acres. Included were 140 acres of heavy ribes eliminated by the power spray method from under and entwined with fallen trees in the blowdown, and logs left along trails and creeks from ski trail clearings.

## Grand Teton National Park

No white pine blister rust control work was performed in 1963. Inspections of the Snake River-Deadman Bar control unit, indicate that the ribes seedling problem in the original heavy ribes sites is diminishing. A number of ribes examined near, but outside, the control unit boundaries, were badly infected with blister rust. Several hundred white pines in the vicinity of Jenny Lake were examined for the disease with negative results.

## Surveys

In Yellowstone National Park an additional 56,390 acres in the Grebe Lake area were surveyed in 1963. This white pine-ribes distribution survey will be used as a basis in assessing the possibility of extending the white pine blister rust control program in the Park.

In Rocky Mountain National Park a preliminary survey was made on 390 acres in preparation for extending the Hidden Valley tentative control unit boundary to natural barriers east of the Many Parks Curve overlook.

In Glacier National Park a preliminary stocking-disease survey was made on 1,230 acres of western white pine type near the old Flathead River Ranger Station. These data will not be analyzed until additional information is obtained in 1964.

## Scouting

To determine the spread and intensification of white pine blister rust as pertinent to Yellowstone, Grand Teton and Rocky Mountain National Parks, a number of casual and systematic inspections were made. A considerable number of trees and ribes were examined in conjunction with the white pine-ribes distribution surveys.

A total of 6,720 white pines and 8,600 ribes were carefully examined in 26 drainages in the Parks and on three adjacent National Forests. Infection was found on white pine in two new locations in Yellowstone. Two cankers were found in the Obsidian Cliff area and one canker near the Tower Fall campground. Intensification of the disease is continuing at a rapid rate outside but in the vicinity of the Mammoth limber pine control unit.

No new ribes or white pine infection centers were found in or adjacent to Grand Teton or Rocky Mountain National Parks. However, an unusually large number of infected ribes were noted in previously known ribes infection centers in Grand Teton and vicinity.

## Summary

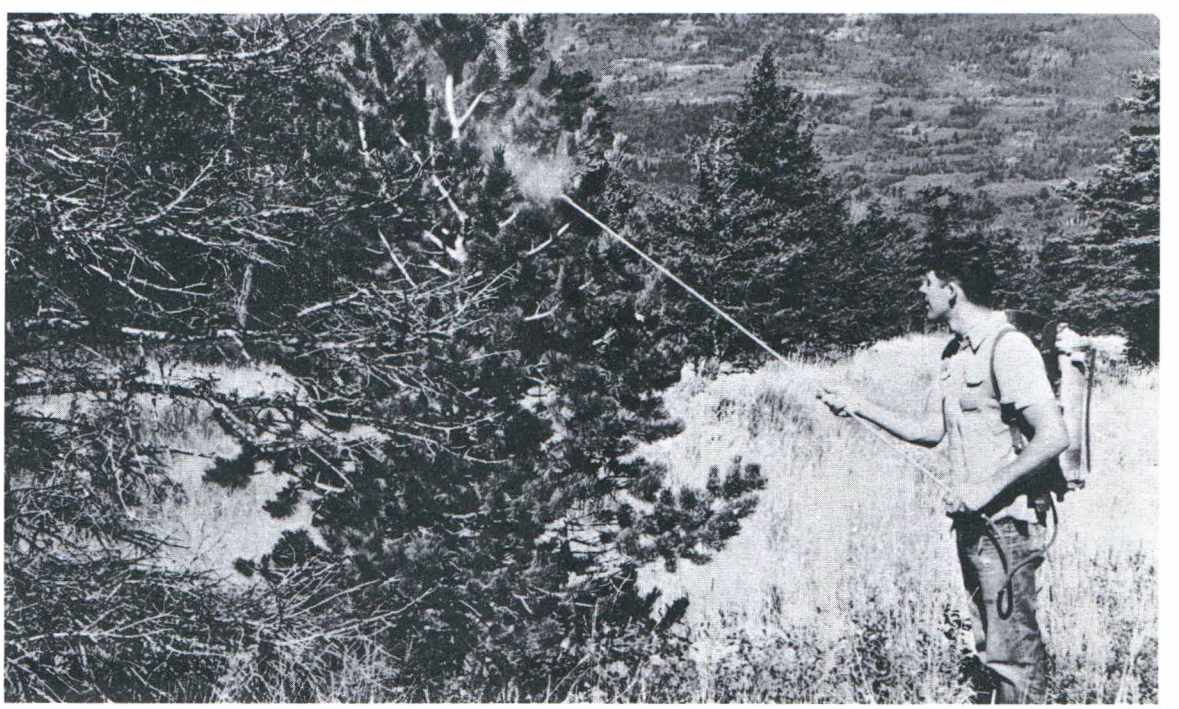
The National Park Service Midwest Region's white pine blister rust control program is being performed in accord with the long-range plan. All work schedules are predetermined and based on pathological and other factors related to control and/or prevention of rust introduction. All work scheduled through 1963 has been completed as planned.

The revised long-range estimate and future work schedules allow for immediate use of the aerial antibiotic foliar spray method on the heavily infected stands of whitebark and limber pine in Glacier, when an effective foliar spray formulation is found. The long-range estimate also reflects the possible inclusion of some additional highly valuable stands of seedling-to pole-size whitebark pine in Yellowstone, if determined desirable.

The disease is rapidly intensifying and spreading southward from known infection centers in Yellowstone. It has been found on pine and in increasing abundance on ribes in Grand Teton. However, only one canker has ever been found in all of the control units in Yellowstone, Grand Teton, and Rocky Mountain. The single pine infection was of 1945 origin, and had occurred before ribes eradication had been initiated in the area.

Performing ribes eradication before infection occurs, and continued timely maintenance of the control areas, are the important factors contributing to successful prevention of establishment and/or control of the rust in the white pine units of Yellowstone, Grand Teton, and Rocky Mountain National Parks.

Blister rust canker on a small limber pine fruiting for the second time in 1962. This tree was dead in 1963, Yellowstone National Park.



Hi-Fog sprayer with long mist nozzle used in foliar spraying trees in the Hudson Bay Divide study plots. This mist maker develops 1,000 p.s.i. at the nozzle.

## II. ANTIBIOTIC DEVELOPMENT AND IMPROVEMENT WORK IN WHITE PINE BLISTER RUST CONTROL - 1963

The Methods Development and Improvement Branch for forest disease control is located in Spokane, Washington, and is composed of the following personnel:

Virgil D. Moss, Pathologist
Wayne E. Bousfield, Forester
Donald H. Brown, Pathologist
John F. Breakey, Equipment Specialist
Elizabeth S. Guillot, Clerk
Lola D. Becker, Laboratory Technician

Progress in the development and improvement of blister rust control methods for the calendar year 1963 has included: (1) tree infection examinations to evaluate test results in aerial and hand applied spray solutions, (2) new plot establishment in aerial and hand spraying, (3) program expansions of antibiotic tests on whitebark and limber pines in Glacier National Park, (4) artificial inoculation of western white pine in the nursery and field to determine antibiotic treatment protection periods against new blister rust infections, (5) collection of foliage and bark samples from treated trees to quantitatively measure by bioautographic and chromatographic laboratory procedures the absorption, translocation, and persistence of antibiotics, and (6) laboratory testing of antibiotic concentrates, spray solutions, oils, and water used in the preparation of aerial and basal stem spray solutions.

### A. Nursery and Reproduction Studies

The protection of western white pine plantations and natural reproduction from blister rust infections is an intricate phase of the blister rust control program. Small white pines are vulnerable to blister rust infections when grown in close association with ribes and when microclimate conditions are favorable.

The purpose of protective nursery and reproduction studies is to develop methods of antibiotic application that will maintain adequate antifungal antibiotic material in the needles and prevent sporidial germ tube development following needle penetration.

Application methods tested to date are aqueous soil drench, root slurry, foliar spray, foliar dip, complete dip, soil tablet, root aqueous absorption, and soil treatment with powder forms of antibiotics.

#### 1. Seedling studies.

##### a. Status of 1961 nursery tests.

A statistically designed study was started in May 1961 to test Phytoactin aqueous foliar sprays as a protectant against white pine blister rust infections (fig. 1). Phytoactin 100, 200, and 300 p.p.m. with and without Triton X-155, 0.1 percent was applied as an aqueous foliar spray to 2-1 western white pine seedlings. Four spray schedules were made to compare differences of seasonal applications and effect of double and triple applications. No additional antibiotic treatment has been made since

Figure 1.--Phytoactin foliar spray study, 1961. Stakes among trees represent infected seedlings.

September 1961. All trees were artificially inoculated in September 1961 and again in September 1962 (table 1).

Table 1.--Results after 1961 and 1962 artificial inoculation of western white pine seedlings treated with Phytoactin foliar sprays in 1961

| Spray schedule | Phytoactin concentration (p.p.m.) | Percent seedlings infected after two inoculations | | |
|---|---|---|---|---|
| | | Without Triton | With Triton | Average |
| June | 0 | 87 | 80 | 84 |
| June, September | | 84 | 42 | 63 |
| June, July, September | | 95 | 62 | 78 |
| September | | 91 | 58 | 74 |
| June | 100 | 81 | 82 | 82 |
| June, September | | 54 | 54 | 54 |
| June, July, September | | 71 | 71 | 71 |
| September | | 71 | 50 | 60 |
| June | 200 | 83 | 91 | 87 |
| June, September | | 62 | 46 | 54 |
| June, July, September | | 46 | 58 | 52 |
| September | | 58 | 30 | 44 |
| June | 300 | 83 | 91 | 87 |
| June, September | | 46 | 50 | 48 |
| June, July, September | | 73 | 54 | 63 |
| September | | 25 | 28 | 27 |

Results after two inoculations can be summarized as follows:

(1) Eighty-nine percent of the untreated seedlings are infected.

(2) Treatments applied only in June did not offer protection.

(3) Treatments of 300 p.p.m. applied in September alone are 27 percent infected.

(4) There was no advantage of adding 0.1 of 1 percent Triton X-155 to the aqueous solution.

(5) Treatments that received only Triton and water are 60 percent infected.

(6) No tree mortality or undesirable side effects have occurred from any treatment.

b. New studies.

Major emphasis in new seedling immunization studies was to increase antibiotic concentrations and to investigate antibiotic combinations.

(1) One study was initiated at the Coeur d'Alene Nursery in May 1963. Treatments consisted of foliar dip, complete dip, and foliar spray. Phytoactin and Venturicidin,1/ two antifungal antibiotics, were applied as separate dips and sprays at 300, 600, and 1,200 p.p.m. aqueous solutions to 2-1 western white pine seedlings. These two antibiotics were also combined in solution as follows: Phytoactin, 300 p.p.m., and Venturicidin, 600 p.p.m.; Phytoactin, 300 p.p.m., and Venturicidin, 300 p.p.m.; Phytoactin, 600 p.p.m., and Venturicidin, 300 p.p.m. Complete dips and foliar dips were applied when seedlings were transplanted in May. Foliar sprays were applied in June, August, and September. Some of these trees were foliar sprayed all three seasons. No treatment has shown phytotoxicity to date. All seedlings were artificially inoculated in October 1963. Preliminary results will be known in September 1964.

(2) Western white pine 2-1 seedlings received a root treatment of four different Phytoactin formulations in June 1963 at the Coeur d'Alene Nursery. Root treatments are comprised of (a) Phytoactin, 200 mg. tablet placed in the bottom of the planting hole, (b) Phytoactin, 1 percent, root slurry dip, (c) Phytoactin L-428, 22 gram, incorporated into soil before planting, (d) Phytoactin L-428 aqueous solution, root dip prior to planting, and (e) no treatment. Each treatment contained 60 seedlings planted in four groups of 15 in randomized blocks (fig. 2).

Seedling survival in September 1963 was as follows:

| Treatment | Percent survival |
|---|---|
| Untreated | 99 |
| Slurry, 1 percent | 100 |
| Tablet, 200 mg. | 42 |
| L-428, 22 gr. | 7 |
| L-428, root dip | 0 |

Tablets were recovered from some of the dead trees in the 200 mg. tablet test. Figure 3 shows Phytoactin tablet after 4 months in the soil. All seedlings were artificially inoculated in October 1963. Preliminary results will be known in September 1964.

1/ The name of Venturicidin has been changed to Murventin.

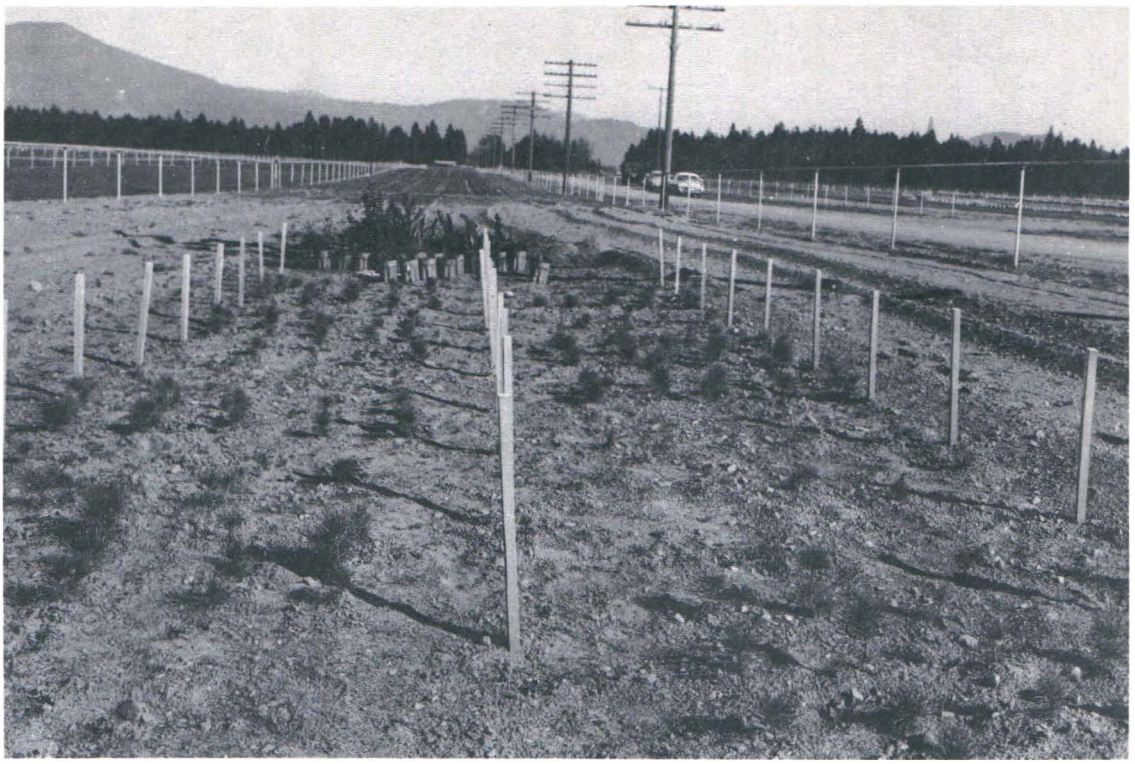


Figure 2.--Phytoactin root treatment. Note high tree mortality in certain blocks.

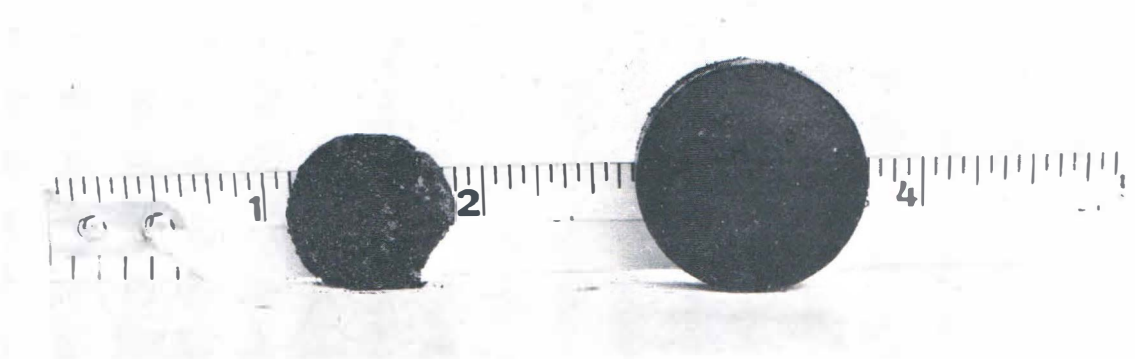



Figure 3.--Tablet on left was recovered after 4 months in the soil. Tablet on right shows original size.

2. Inoculation equipment.

A portable metal frame was used in September and October 1963 to support the polyethylene and canvas coverings for the artificial inoculations of nursery study stock. The frames were constructed of 1-1/4-inch thin wall electrical conduit and fastened together by 1-inch pipe fittings. Wheels were installed to facilitate moving the frames for short distances. Wood rafters were used to provide air circulation space between the polyethylene and canvas covers. Measurements for each unit are 10'x10'x5'6" high. Three units can be assembled together to inoculate an area 10'x30' (fig. 5).

3. Treated white pine planting stock.

Outplantings of Phytoactin-treated western white pine nursery seedlings were established on each of the five white pine Forests in May 1963. All white pine nursery stock shipped to the Forests from the Savenac and Coeur d'Alene Nurseries in the spring of 1963 received a Phytoactin, 200 p.p.m. foliar dip treatment before shipment. The outplanting study for each Forest consisted of 200 of these treated seedlings and an equal number of untreated seedlings. Mortality rates for outplantings were the same for treated and untreated seedlings when inspected in August 1963. The study plot locations were selected in recently burned over areas outside ribes eradication units where ample natural infection should occur.

Phytoactin, 400 p.p.m. aqueous solution was sprayed on all 2-0 or older white pine seedlings in both Forest Nurseries in September 1963 prior to fall planting. None of the planting stock used during the fall 1963 season received any other kind of antibiotic treatment.

4. Reproduction studies.

a. Status of 1962 studies.

A tree series of 5- to 10-year-old western white pine reproduction was treated with oil base solutions of Phytoactin L-439 and L-440 applied as a foliar drench near Deep Creek on the St. Joe National Forest in July 1962. Each study tree had at least one damaging branch or incipient stem canker. Twenty trees each were given one of the antibiotic treatments. An additional 20 trees were treated with No. 1 stove oil alone, and an equal number left untreated. All needles and stems of the treated trees were drenched with the different solutions by spraying. All trees and cankers were examined in June 1963. Terminal growth was observed to be damaged to some degree by all of the sprays. Heaviest damage occurred on the Phytoactin L-439 and the L-440 treated trees, although oil alone also damaged terminal growth to some extent.

Figure 4.--Coeur d'Alene Nursery.

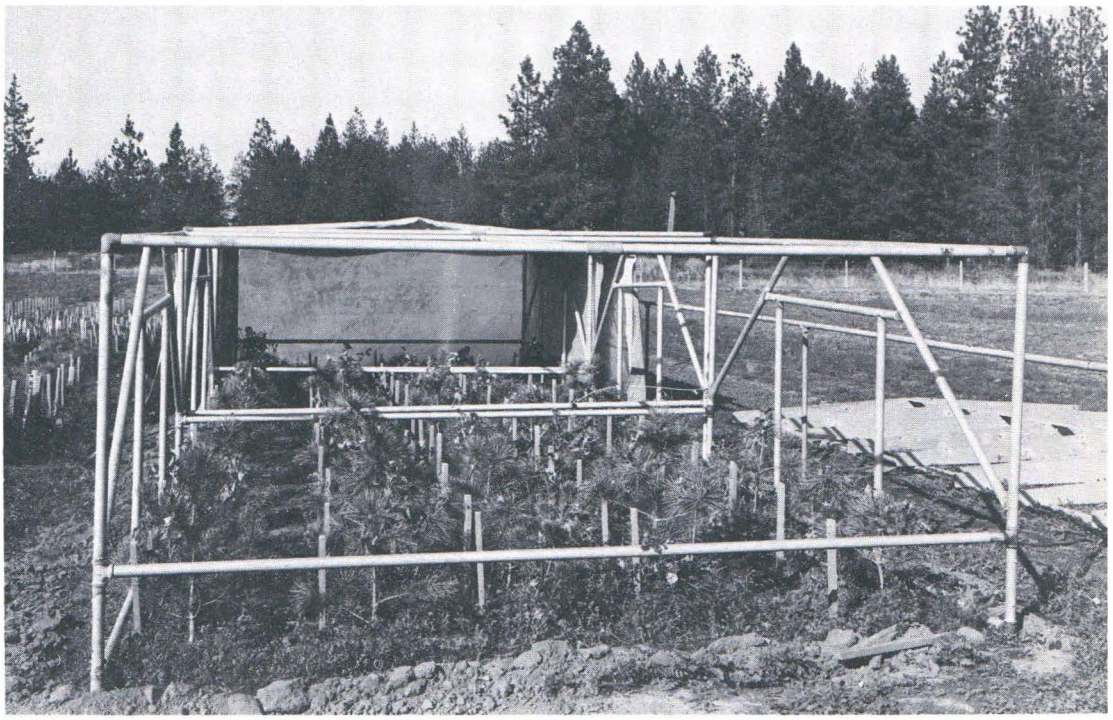


Figure 5.--Partially covered inoculation chamber.

Results to date are as follows:

| Antibiotic | P.p.m. | Carrier | Percent infection control |
|---|---|---|---|
| Phytoactin L-439 | 200 | Oil | 25 |
| Phytoactin L-440 | 200 | Oil | 22 |
| None | -- | Oil | 13 |
| None | -- | -- | 4 |

b. New studies.

A series of antibiotic treatments were applied on 5- to 10-year-old western white pine in June 1963 to determine infection control and degree of immunity against new infections. A heavily infected stand outside a white pine protection unit was selected near Deep Creek on the St. Joe National Forest. Thirty trees were selected for each treatment. Most trees had more than one canker and one had eight damaging branch cankers. The outer limits of discoloration on all infections were marked with pins at time of treatment for future observations. Treatments were as follows:

| Antibiotic | P.p.m. | Carrier | Method |
|---|---|---|---|
| Venturicidin | 150 | Oil emulsion, 20% | Foliar spray |
| Venturicidin | 600 | Oil emulsion, 20% | Foliar spray |
| Venturicidin with Phytoactin mix | 600 (300-300) | Oil emulsion, 20% | Foliar spray |
| Phytoactin | 200 | Oil emulsion, 20% + Triton X77, 1% | Foliar spray |
| Venturicidin | 200 | Oil + methylene chloride, 10% | Canker drench |
| Acti-dione | 300 | Oil | Stem drench |
| Untreated | -- | -- | Controls |

B. Aerial Spraying Studies

1. Status of tests.

Cankers were classified either live, dead, or controlled in the examination of test tree results this year. Visual criteria for live infections were based on aeciospore and pycniospore stages of the rust, bark discoloration, canker parasitism by the purple mold fungus, Tuberculina maxima, and fresh rodent chewing. Cankers were classified dead only if all diseased bark was necrotic, callus growth was visible on more than half the canker margin perimeter, and there was no evidence of any of the live criteria. Cankers were recorded controlled if there were no sporulation or recent rodent chewing, and

there had been no advancement in mycelial growth as evidenced from annual bark discoloration measurements. Controlled cankers are those with infection remnants occurring only as a small spot or spots of discoloration visually static in growth with or without Tuberculina maxima and with waning color characteristics. Several cankers classified dead in previous examinations on the absence of live symptoms were placed in this controlled category because callus growth was less than 50 percent of the original canker perimeter. Test trees in the aerial spray plots will continue to be examined each year until all infections are classified either dead or live.

Cycloheximide aerial spray tests, except for a few plots, are no longer being evaluated. A few are being carried to observe rate of canker regrowth and to provide foliage samples for cycloheximide residue studies. Cycloheximide had an inhibitory effect of sporulation that persisted through the first growing season after spraying. Thereafter, there was a gradual increase in aeciospore and pycniospore production until infections reached normal sporulation the third year after spraying. Several cankers were killed outright but regrowth and spreading of remnant infections have become quite general. This is true whether the purple mold fungus Tuberculina maxima was or was not present. Cycloheximide semicarbazone was the most promising of the derivatives followed by thiosemicarbazone and methylhydrazone. All were highly phytotoxic to western white pine causing trees to cast 2- and 3-year-old needles in less than 2 weeks after spraying.

Table 2.--Phytoactin aerial spray results

| Plot no. | Stand age | Spray date | Phytoactin formulation | | Grams-gallons per acre | | Canker status, percent 1963 results | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Number | Carrier | Grams | Gallons | Dead | Controlled | Live |
| St. Joe National Forest | | | | | | | | | |
| 1 | 60-80 | June 1959 | L-317 | water | 3.8 | 10 | 51 | 70 | 1/30 |
| 2 | 60-80 | June 1959 | L-318 | water | 7.6 | 10 | 63 | 81 | 19 |
| 3 | 60-80 | June 1959 | L-319 | water | 15.2 | 10 | 67 | 86 | 14 |
| Check | 60-80 | June 1959 | Check | none | 0.0 | 0 | 3 | 3 | 97 |
| 9 | 20-40 | June 1959 | L-317 | water | 3.8 | 10 | 53 | 76 | 24 |
| 7 | 20-40 | June 1959 | L-318 | water | 7.6 | 10 | 66 | 87 | 13 |
| 8 | 20-40 | June 1959 | L-319 | water | 15.2 | 10 | 62 | 83 | 17 |
| Check | 20-40 | June 1959 | Check | none | 0.0 | 0 | 5 | 5 | 95 |
| 22 | 60-80 | June 1960 | L-318 | water | 7.6 | 5 | 44 | 66 | 34 |
| 23 | 60-80 | June 1960 | L-318 | 10% oil | 7.6 | 5 | 48 | 78 | 22 |
| 24 | 60-80 | June 1960 | L-318 | 20% oil | 7.6 | 5 | 56 | 77 | 23 |
| 15 | 60-80 | June 1960 | L-318 | water | 7.6 | 10 | 47 | 73 | 27 |
| 16 | 60-80 | June 1960 | L-318 | 10% oil | 7.6 | 10 | 52 | 82 | 18 |
| 17 | 60-80 | June 1960 | L-318 | 20% oil | 7.6 | 10 | 63 | 86 | 14 |
| 18 | 60-80 | June 1960 | L-382 | 20% oil | 7.6 | 10 | 62 | 83 | 17 |
| 19 | 60-80 | June 1960 | L-387 | 20% oil | 7.6 | 10 | 38 | 60 | 40 |
| 20 | 60-80 | June 1960 | L-390 | 20% oil | 7.6 | 10 | 49 | 66 | 34 |
| 21 | 60-80 | June 1960 | L-395 | 20% oil | 7.6 | 10 | 27 | 44 | 56 |
| Check | 60-80 | June 1960 | Check | none | 0.0 | 0 | 7 | 7 | 93 |
| Coeur d'Alene National Forest | | | | | | | | | |
| 4 | 20-40 | September 1960 | L-318 | 20% oil | 7.5 | 7 | 59 | 88 | 12 |
| 5 | 20-40 | September 1960 | L-395 | 20% oil | 7.5 | 7 | 34 | 53 | 47 |
| 8 | 18 | June 1961 | L-318 | 20% oil | 7.5 | 10 | 53 | 84 | 16 |
| Check | 20-40 | June 1961 | Check | none | 0.0 | 0 | 4 | 4 | 96 |

1/ Controlled plus alive equals 100 percent. The controlled percentage includes those infections classed as dead.

Table 3.--Cycloheximide aerial spray results

| Plot no. | Stand age | Spray date | Cycloheximide derivative and carrier | Grams-gallons per acre | | Canker status, percent 1963 results | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Grams | Gallons | Dead | Controlled | Live |
| Coeur d'Alene National Forest | | | | | | | | |
| 1 | 20-40 | September 1960 | Methylhydrazone 20% oil | 7.6 | 7 | 14 | 22 | 1/78 |
| 2 | 20-40 | | Semicarbazone 20% oil | 7.6 | 7 | 26 | 35 | 65 |
| 3 | 20-40 | | Semicarbazone GAB-1 - water | 7.6 | 7 | 18 | 27 | 73 |
| 6 | 20-40 | | Methylhydrazone GAB-3 - water | 7.6 | 7 | 11 | 16 | 84 |
| 7 | 20-40 | | Semicarbazone GAB-2 - water | 7.6 | 7 | 9 | 11 | 89 |
| Check | 20-40 | | check | 0.0 | 0 | 4 | 4 | 96 |
| St. Joe National Forest | | | | | | | | |
| 12 | 20-40 | June 1959 | Semicarbazone water | 7.6 | 10 | 41 | 54 | 46 |
| Check | 20-40 | June 1959 | check | 0.0 | 0 | 5 | 5 | 95 |
| 29 | 60-80 | June 1960 | Semicarbazone 20% oil | 7.6 | 10 | 38 | 45 | 55 |
| Check | 60-80 | June 1960 | check | 0.0 | 0 | 7 | 7 | 93 |

1/ Controlled plus alive equals 100 percent. The controlled percentage includes those infections classed as dead.

2. New tests.

Substitution of light cycle oil (aniline point 96° F.) for western No. 1 fuel oil (aniline point between 140° and 150° F.) in the preparation of 20 percent oil emulsion in aerial spraying Phytoactin L-318 was tested in the Kootenai National Forest, Montana. Venturicidin in 20 percent oil (western No. 1 fuel oil) emulsion was also applied by helicopter to a test plot in the Coeur d'Alene National Forest, Idaho.

C. Foliar Spray Studies (Mistblower - Clearwater National Forest)

A definite need exists to develop a foliar application of an antibiotic capable of inducing disease resistance and infection eradication properties in 5- to 15-year-old white pine. This need is particularly apparent in the extensive stands of reproduction on the Clearwater National Forest and adjoining state and private lands.

Three test plots situated in a cutover area supporting natural reproduction on Potlatch Forests, Inc., lands near Pierce, Idaho were sprayed in October 1963 using a Solo Port-60 backpack mistblower. The actual mechanics of applying the antibiotic solution with the mistblower was considered to be a very successful operation warranting further tests. Trees possessing branch and stem infections with aggressively advancing margins in initial or intermediate stages of development were selected for future treatment evaluation. The treatments are described in the following tabulation:

| Plot no. | Antibiotic | Spray solution: Concentration (p.p.m.) | Spray solution: Carrier | Plot area (acres) | Solution applied 1/ (gallons) | Trees treated (number) |
|---|---|---|---|---|---|---|
| 1 | None | none | 20% oil emulsion | 0.3 | 2.0 (6.6) | 114 (checks) |
| 2 | Phytoactin L-318 | 800 | 20% oil emulsion | 0.7 | 2.5 (3.6) | 258 |
| 3 | Phytoactin L-318 | 400 | 20% oil emulsion | 0.4 | 2.5 (6.2) | 200 |

1/ Number in parentheses indicates theoretical application in gallons per acre determined from amount actually used and plot size.

Additional trees treated in 1963, but not specifically reserved for treatment evaluation, are scheduled to be artificially inoculated in 1964 to assess their infection immunity. Foliage material collected 1 week after treatment will be analyzed in the laboratory in an attempt to relate quantitative measures of residual antibiotic to foliage absorption and method of application.

D. Basal Stem Studies

1. Three formulations of cycloheximide and three formulations of Phytoactin were tested on 10- to 15-year-old western white pine in June and September 1961. Cycloheximide formulations included Acti-dione BR, Acti-dione 3X, and Naramycin. Concentrations of cycloheximide formulations were 150 p.p.m. Phytoactin concentrations were 150, 200, and 250 p.p.m. All Phytoactin formulations were mixed in isoproponal solvent before mixing with oil. Thirty trees in each treatment were used as a tree basis. Results to date are shown in Table 4.

Table 4.--Second-year results in applying several antibiotics in the spring and in the fall seasons by the basal stem method to 10- to 15-year-old western white pine on the St. Joe National Forest

| Antibiotic formulation | P.p.m. | Lethal stem and branch cankers with negative symptoms (controlled) 2 years after treatment | |
|---|---|---|---|
| | | Treatment date | |
| | | June 15, 1961 | September 15, 1961 |
| Acti-dione + Triton B-1956 | 150 | 67 | 47 |
| Naramycin | 150 | 69 | 21 |
| Naramycin + Triton B-1956 | 150 | 77 | 43 |
| Cycloheximide 3X | 150 | 52 | 1/-- |
| Phytoactin L-426 | 150 | 26 | 27 |
| Phytoactin L-348 | 200 | 39 | 13 |
| Phytoactin L-427 | 250 | 22 | 31 |
| Untreated | -- | 11 | 11 |

1/ No plot established in September.

2. The moisture on trunk study established in 1961 further shows that Acti-dione BR oil solution used in the basal stem method must not be applied to trees when trunk surface is wet from dew, rain, or snow. Acti-dione, 150 p.p.m., diluted in No. 1 fuel oil containing Triton B-1956 surfactant to prevent cycloheximide crystallization was applied under four trunk surface conditions: (1) trunk surface dry when sprayed, (2) sprayed dry followed by wetting surface with water, (3) surface wet with water prior to spraying, and (4) bark surface wet with water both before and after spraying.

| Trunk surface treatment | Second-year results Percent cankers | |
|---|---|---|
| | Dead | Controlled |
| Dry-treat | 54 | 71 |
| Dry-treat-wet | 21 | 26 |
| Wet-treat | 4 | 4 |
| Wet-treat-wet | 0 | 0 |
| Untreated | 0 | 0 |

E. Whitebark Pine Studies

(Hudson Bay Divide, Glacier National Park)

An inspection party comprised of National Park Service personnel, Forest Service Pest Control personnel, and Jack Ziffer, Pabst Laboratories, Milwaukee, Wisconsin, reviewed various antibiotic treatments on whitebark and limber pines in Glacier National Park in July 1963. Although the results of these tests are still inconclusive, some of the basal stem treatments are encouraging.

A new series of basal stem and foliar treatments on whitebark pine was recommended and initiated following the inspection trip. Suitable test trees were selected in pine stands adjacent to study plots established in 1961 and 1962 at Hudson Bay Divide. Table 5 describes the principle treatments applied in August and September 1963.

The test plots are scheduled for annual examinations to determine effects of treatment. Tree tissue and spray solution samples collected from representative treatments will be bioassayed in the laboratory to determine the presence and amount of antibiotic. A new series of foliar treatments (planned for July 1964) will be applied in the flush growth period using a gasoline-powered backpack mistblower. Foliar treatments will receive first priority in future tests since the extensive stands of limber and whitebark pine present in the West can probably be most effectively treated by this method of application.

Table 5.--Basal stem and foliar treatment of whitebark pine in August and September 1963 at Hudson Bay Divide, Glacier National Park

| Treatment | Antibiotic | Spray solution | | No. trees | Number cankers |
|---|---|---|---|---|---|
| | | Treatment, p.p.m. concentration | Carrier | | |
| Checks and controls | None | None | None | 80 | 220 |
| Basal stem and direct canker[1/] | Phytoactin L-440 | 200 | Oil | 20 | 54 |
| | Venturicidin | 200 | Oil | 20 | 74 |
| | Phytoactin L-440 with Venturicidin mixture | 200 | Oil | 20 | 62 |
| Foliar spray | Phytoactin L-440 | 200 | Oil | 30 | 73 |
| | Venturicidin | 200 | Oil | 20 | 69 |
| | Phytoactin L-440 with Venturicidin mixture | 200 | Oil | 20 | 44 |
| Foliar spray | Phytoactin L-318 | 200 | 20% oil emulsion | 30 | 64 |
| | Phytoactin L-318 | 400 | 20% oil emulsion | 20 | 63 |
| | Phytoactin L-319 | 400 | 20% oil emulsion | 20 | 64 |
| | Venturicidin | 200 | 20% oil emulsion | 20 | 54 |
| | Phytoactin L-318 with Venturicidin mixture | 200 | 20% oil emulsion | 10 | 24 |
| | Phytoactin L-461 | 200 | 20% oil emulsion | 10 | 23 |
| | Phytoactin L-462 | 200 | 20% oil emulsion | 10 | 18 |
| Foliar spray | Phytoactin L-383 | 200 | Water | 10 | 27 |
| Miscellaneous absorption and translocation studies | | | | 135 | 81 |
| | | | | 475 | 1,013 |

1/ Perimeters of stem cankers and lower trunk surfaces on half of the trees were scarified with a chisel-type implement fitted with a rowel.

F. Cooperation

Basic research in Phytoactin activity under the Washington State University-Pabst Laboratories cooperative project has two objectives: (1) to develop qualitative and quantitative chemical, biological, or serological assay procedures for Phytoactin concentrations in treated plant tissues, and (2) to measure the efficacy of Phytoactin uptake, distribution, and accumulation in plant tissues in relation to environmental and physiological conditions. Progress was made during 1963 in the isolation, purification, and measurement of Phytoactin or its derivatives from treated plant tissues. The Phytoactin study is under the direction of Dr. C. Gardner Shaw, Department Chairman, and Dr. S. O. Graham, Associate Professor and Plant Pathologist, Department of Plant Pathology. Three graduate students, Alan Harvey with stipend provided by Pabst Laboratories, and Simean Leach and Martin Stoner with stipend provided by the Department of Plant Pathology through the Washington State Agricultural Experiment Station, have assisted in the study.

Canadian and United States forestry and industrial visitors in calendar year 1963 included:

Pabst Laboratories

Dr. Alex Sigal - Technical Director, Microbiological and Chemical Research, Milwaukee, Wisconsin
Dr. Jack Ziffer - Director of Microbiological Research, Milwaukee, Wisconsin

British Columbia, Canada

D. R. Glew - Forester, Management Division, British Columbia Forest Service, Victoria, B.C., Canada
S. Z. Cinar - Forester, Management Division, British Columbia Forest Service, Victoria, B.C., Canada
Philip G. Haddock - Associate Professor, Faculty of Forestry, University of British Columbia, Vancouver, B.C., Canada
L. C. Weir - Forest Pathologist, Forest Entomology and Pathology Branch, Department of Forestry, Victoria, B.C., Canada
W. S. Hough - Silviculturist, Forest Service, Office of District Forester, Nelson, B.C., Canada

U.S. Forest Service

John R. Hansbrough - Director, Division of Forest Disease Research, Washington, D.C.
Conrad P. Wessela - Head, Section of Disease Control, Washington, D.C.

## III. DEVELOPMENT OF BLISTER RUST RESISTANT WHITE PINE - 1963

Developmental work under the long-range program for breeding blister rust resistant western white pine entered its fourteenth year in 1963. Occurrence of a bumper white pine flowering year materially aided the work. In fact, heavy male and female flowering so accelerated the test crossing work that the standard four test cross pollinations were completed on a total of 111 new "candidate" trees; this was almost double the number of new candidates covered in any previous season.

This developmental work is performed by Intermountain Station personnel, but is financed - under Memorandum of Understanding - by Region 1. A scientist-technician team undertakes annually about 4-1/2 man-years of work, aimed at the practical aspects of mass production of semiresistant white pine planting stock. The underlying breeding scheme and progress thereunder are outlined in Table 1.

Table 1

| Steps in the breeding scheme | Progress through 1963 |
|---|---|
| 1. Selection of rust-free "candidate" trees in unprotected, heavily infected natural stands. | 385 candidates located (400 wanted). |
| 2. Controlled crossing of candidates using pollen from four "test" trees. | 310 candidates test-crossed. |
| 3. Resistance testing of $F_1$ test-cross progenies, commencing with artificial inoculation and continuing with annual rust examinations. | 210 candidates, each with four $F_1$ test-cross progenies in nursery, 170 with $F_1$'s inoculated once or more. |
| 4. Reselection of candidates for general combining ability for resistance, i.e., on the basis of all four test-cross progenies exhibiting significantly better rust survival than controls. | 25-30 candidates reselected out of 110 fully or tentatively appraised. |
| 5. Remating of "general-combiner" candidates, both from within the same elevational zone. | 14 general-combiners remated in 7 $F_1$'s. |
| 6. Culling of general-combiner $F_1$ progenies by artificial inoculation to eliminate susceptible types, then conservation of surviving seedlings to multiply scionwood. | 3 general-combiner $F_1$'s representing 6 reselected candidates now in the scionwood "bank." |
| 7. Establishment of $F_2$ seed orchards for production of low-, mid-, and high-elevation seed. | Grafting scheduled to begin in 1970, rootstocks under production for 1966 establishment. |

In 1963 we have about reached the halfway point in the work. Each successive year the various candidates move downward, through the steps of Table 1. In the period 1965-1970 we should reach the goal of about 25 reselected trees for each of three elevational zones, remated within elevational zones to provide half that number of general-combiner $F_1$'s.

Present plans call for grafting of scionwood from the oldest of these, beginning in 1970 and continuing with about 20 acres of seed orchard (2,000 grafts) per year through 1974. Preplanted rootstocks will then be 8-11 years old, scions from the "bank" will be mostly from 6-year-old $F_1$'s. Seed produced after about 1985 will be unselected $F_2$ seed and should average better than 50 percent survival under root conditions in the field.

Research work in advanced-generation breeding, in interspecies breeding, and in biochemistry of rust resistance continues. The Intermountain Station finances this work, amounting annually to about 3-1/2 man-years of work.

## IV. MECHANICAL IMPROVEMENTS FOR WHITE PINE BLISTER RUST CONTROL - 1963

### A. Stake Truck Slip-on Tanks for Water and Oil Supply Service

1. There were three additional flat-topped, round-bottomed, 10 gage steel slip-on tanks purchased for use in 1963.

   These tanks are 6 inches longer than the 1962 model and have a capacity of 960 gallons. Established mixing practice requires a ratio of 80 gallons of water to 20 gallons of fuel oil. The largest batch requires 720 gallons of water. The excess 240 gallons of water is carried over in storage which increases to 720 gallons with two additional truck supply trips.

2. A double section 10-gage tank of 1,380-gallon capacity was also purchased. This tank is shaped similarly to the 960-gallon units. Larger in dimension, it is 132 inches long by 76 inches wide by 32 inches high. The front tank section is 77 inches long and holds 805 gallons. The rear section is 55 inches long and has a capacity of 575 gallons.

   This tank is also mounted on two 4"x6"x144" skids. The front section has two baffles and the rear has one. Each section has a 6-inch fill opening. Two 2-inch outlet pipes are supplied with valves at the rear of the tank. A three-valve manifold gives full control of each compartment. This large unit is carried to helispots on a stake-side truck and used for both water and oil storage. The two-sectioned tank is desirable in limited space areas.

### B. Mixing-Service Tanker for Antibiotics

1. A seventh antibiotic mixing-service tanker was completed in the spring of 1963. This unit is equipped with a 210,000-grain water softener.

2. Purchase of extra tri-rotor pumps for mixing-service tankers was made in an effort to prevent field delays from pump failures. Three tri-rotor pumps, model 80-BV-2", were obtained and reconditioned for field service.

### C. Water Conditioning for Antibiotic Sprays

Variations in water hardness and hydrogen-ion concentration throughout the Region required specialized equipment to minimize their effects on the antibiotic spray solutions. Prespray water testing with subsequent addition of prescribed quantities of sodium bisulfate adjusts the water pH satisfactorily. Softeners were installed at four mixing tanker stations to treat the water before it was placed in an antibiotic spray emulsion.

1. In June, a Bruner model R120-1", 120,000-grain, one-tank softener was purchased. It was equipped with a single lever, 3-position control valve and timer. This softener was supplied with Dowex high capacity resin. Average flow rate is 18 gallons per minute.

An Oberdorfer #1P378, 1-inch geared pump powered by a 5 H.P. Wisconsin engine supplied the water for the softener. The softener was mounted on an Army surplus bomb trailer beside a 1,700-gallon aluminum supply tank. Water was often pumped directly from a stream through the softener and then to the supply tank. The antibiotic mixer pump draws the soft water directly from the aluminum supply tank.

2. Three Bruner model 210C-1½ single lever, multiport, one-tank softeners were purchased in July and installed on antibiotic mixing tankers. These 210,000-grain softeners contain 7 cubic feet of Dowex-ion exchange high capacity resin. Flow rate is 35 gallons per minute maximum. Eighty pounds of Wisconsin flint sand were added as a topping on the filter beds. This was placed directly below the regular resinous bed to guard against "channeling."

A Marine Products Co., model 6200, 1½" geared pump, belt-driven from the mixer engine, supplied water to the softener. Water is pumped through the softener to a supply tank beside the antibiotic mixer. Because of excess gear wear, softener service pumps were replaced with 1½" centrifugal pumps.

In order to clean the water before it enters the softener, a Jacuzzi model FGF-15, seven-element spin-type water filter was installed on each of the 210,000-grain softeners. These are piped in such a manner that they may be recharged with diatomaceous earth once or twice daily. Pressure paint pots were used as recharging chambers. These filters are lightweight and encased in a stainless steel shell. Contaminants may be washed into a waste area.

Filters were first installed without valves for backwashing. It was then necessary to remove the elements for thorough cleaning. They will be replumbed to provide for backwashing and cleaning with one of the synthetic liquid cleaners.

Performance of the filters and softeners was satisfactory. Soft water was always available in ample supply. Some streams yield water filled with crusty hard particles, fine mossy substances, and syrup-like algae which are caught up in the filters.

Recharging of the resin is done with pellet salt marketed as hay and stock salt. Fifty-five pounds are used for the R120, 120,000-grain unit and 100 pounds for regenerating the 210C-1½, 210,000-grain machine.

Field water testing for hardness at the softener outlet was done with the standard soap test kit.

The increase in softener size from 120,000-grain to 210,000-grain doubled the flow of soft water. The slower rate of the small softener requires additional pumping time and storage facilities.

D. Scarifier Spray Wands

There were 249 spray wands equipped with rolling punch and stainless steel top blade distributed to the Forests and National Parks in 1963. The top blade will be extended and made reversible. The following illustration shows the unit with the reversible blade. The extra length should prevent nozzle damage when scarifying the callused bark around a white pine canker prior to spraying with an antibiotic.

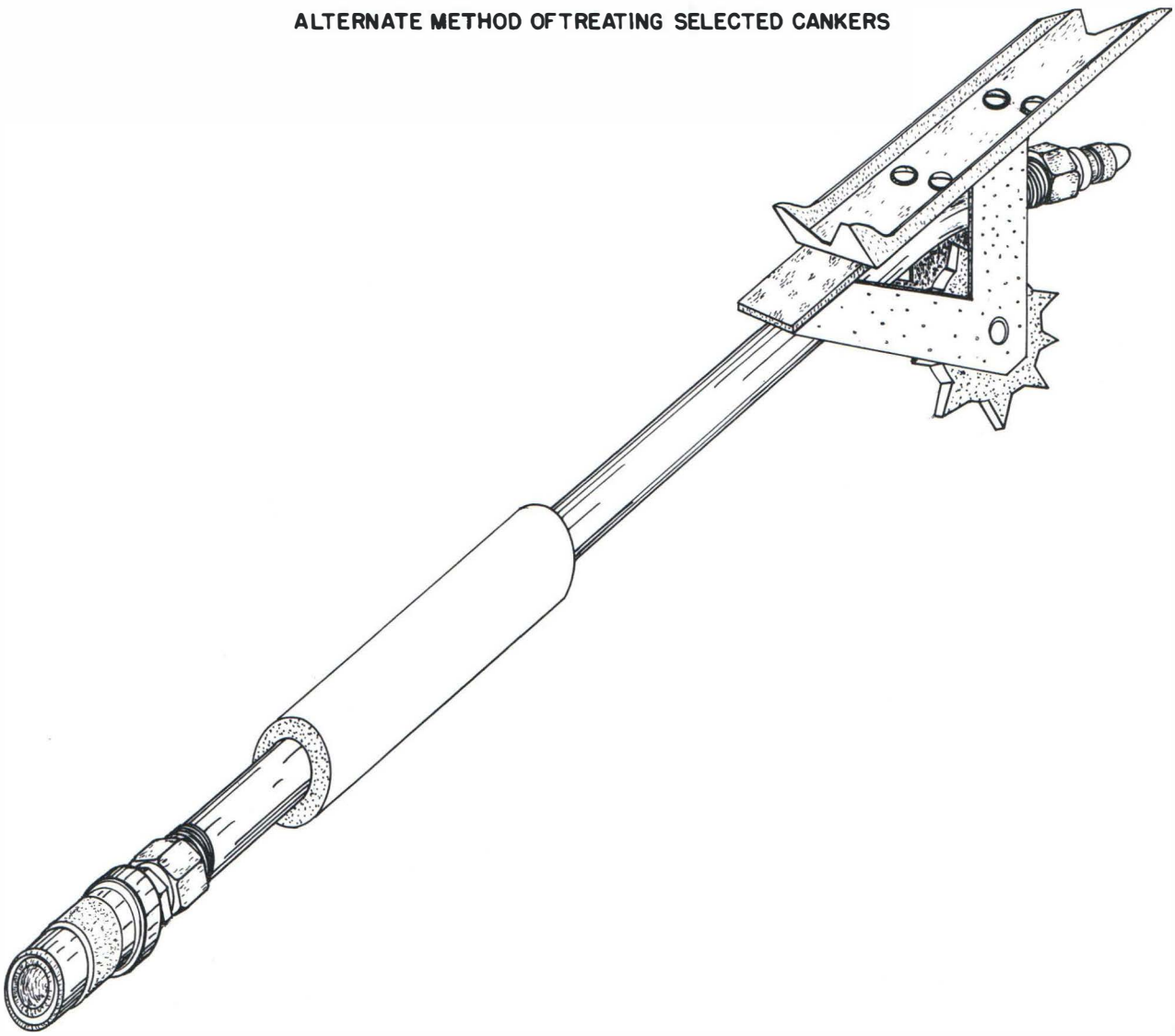
# SCARIFIER

## SPRAY WAND

THE STAINLESS STEEL TOP BLADE IS REVERSIBLE

INCISION BY THE USE OF THE ROLL PUNCH IS MADE AS AN

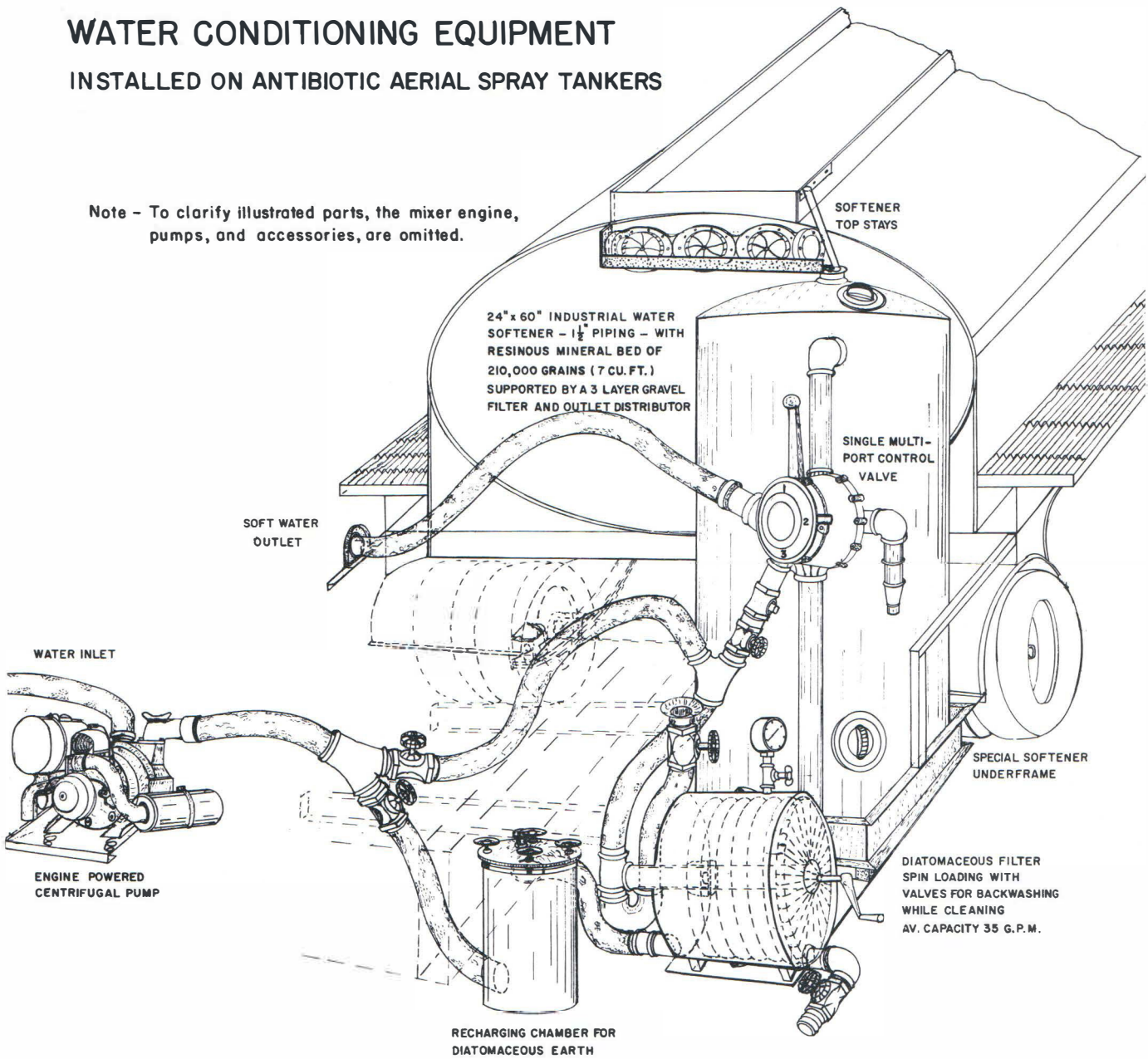
ALTERNATE METHOD OF TREATING SELECTED CANKERS



# WATER CONDITIONING EQUIPMENT

## INSTALLED ON ANTIBIOTIC AERIAL SPRAY TANKERS

Note – To clarify illustrated parts, the mixer engine, pumps, and accessories, are omitted.



## V. AERIAL APPLICATION OF ANTIBIOTICS - 1963

All aerial spraying in 1963 was done with helicopters. The same formulation used in the fall of 1962 of Phytoactin L-318 emulsified in an 80 percent water and 20 percent No. 1 fuel oil with Multi-Film L (surfactant) was used again on all areas. All 1963 spraying was at a rate of 7 gallons with 7.5 grams of Phytoactin L-318 per acre. A total of 12 helicopters were used during both the spring and fall spray seasons. These helicopters were contracted from the following firms:

Avery Aviation, Inc., Greybull, Wyoming - 2 helicopters
Hillcrest Aircraft Co., Inc., Lewiston, Idaho - 4 helicopters
Johnson Flying Service, Inc., Missoula, Montana - 5 helicopters
Mississippi Valley Helicopters, Inc., St. Louis, Missouri - 1 helicopter

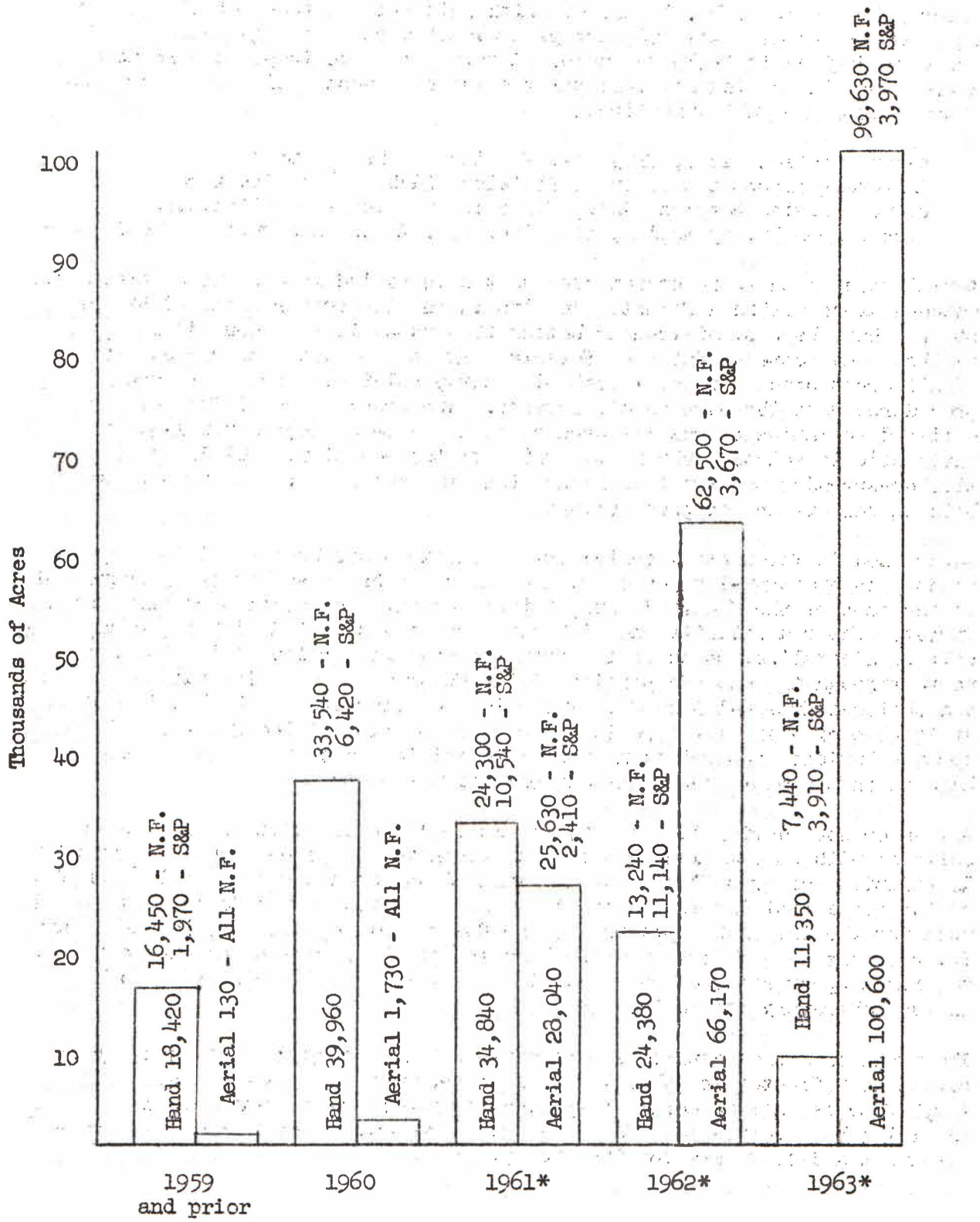
Aerial spray results in operational work have varied more between Forests than between areas within a Forest. Results in the Clearwater followed by the St. Joe have been significantly better than those in the Coeur d'Alene, Kaniksu, and Kootenai National Forests. Except for water source and the use of different brands of No. 1 fuel oil, spray solution ingredients and mixing procedures were the same on all Forests. The brand of No. 1 fuel oil is not believed to influence results because in the case of Phytoactin L-318 the antibiotic is soluble only in the water of the emulsion. Oil is added as a sticker-spreader-penetrant to reduce the evaporation rate of spray solution both in the air and on pine foliage.

Water used in formulating aerial spray solutions has been found to vary greatly in hydrogen-ion concentration and grain hardness between Forests and in the case of the Coeur d'Alene, between eastern and western portions of the Forest. Water alkalinity and high hardness is associated with a geographical belt of mineralization extending from the eastern portion of the St. Joe north through the eastern portion of the Coeur d'Alene to include the Kaniksu and Kootenai National Forests. Water in the Clearwater is both acid and soft. It is also of a similar type in the western portion of the St. Joe. Aerial spray solutions prepared from these more acidic and softer waters appear to have given the most consistent and effective results.

All water used during 1963 in Phytoactin L-318 aerial spray solutions was buffered with sodium bisulfate to a hydrogen-ion range between pH 4 and pH 5. In addition, water softeners were installed during the summer of 1963 on four of the six antibiotic mixing-service units operated in the Region. These were used for the fall 1963 spraying by the Coeur d'Alene, Kaniksu, Kootenai, and St. Joe Forests. Effect of water hardness and hydrogen-ion concentration of the final spray solution on foliar treatment results is being studied both in the laboratory and in the field.

The trend of aerial application of antibiotics in comparison to hand application is reflected in Table 1. It is expected that an annual rate of about 100,000 acres will be aerially sprayed for the next few years until the initial job is completed. Tables 2 and 3 summarize aerial spraying accomplishment and cost data for the 1963 program.

Table 1.--Region 1 Summary of Antibiotic Treatment Through 1963 (National Parks not included)




*Figures include a few acres treated previously where retreatment has been necessary.

Table 2.--Production Summary of 1963 Aerial (Helicopter) Spraying

| No. | Item | Forest | | | | | Total average |
|---|---|---|---|---|---|---|---|
| | | Clearwater | Coeur d'Alene | Kaniksu | Kootenai | St. Joe | |
| 1. | Acres sprayed | 10,490 | 28,820 | 26,860 | 7,650 | 26,780 | 100,600 |
| 2. | Flight hours - actual spraying | 126.7 | 499.6 | 434.7 | 122.4 | 499.0 | 1,682.4 |
| 3. | Flight hours - orientation | 13.7 | 38.3 | 25.1 | 3.9 | 36.6 | 117.6 |
| 4. | Flight hours - base ferry | 6.1 | 26.1 | 25.5 | 10.6 | 18.8 | 87.1 |
| 5. | Number of spray loads (trips) | 1,086 | 3,165 | 2,841 | 817 | 3,007 | 10,916 |
| 6. | Gallons solution sprayed | 75,968 | 222,823 | 197,360 | 57,371 | 197,704 | 751,226 |
| 7. | Spray trips per hour1/ | 8.6 | 6.3 | 6.5 | 6.7 | 6.0 | 6.5 |
| 8. | Gallons sprayed per hour1/ | 600 | 446 | 454 | 469 | 396 | 447 |
| 9. | Gallons solution per trip1/ | 70.0 | 70.4 | 69.5 | 70.2 | 65.7 | 68.9 |
| 10. | Gallons solution per acre | 7.26 | 7.80 | 7.32 | 7.50 | 7.31 | 7.45 |
| 11. | Acres sprayed per hour - actual spray time1/ | 84.6 | 57.7 | 61.8 | 62.5 | 53.7 | 59.9 |
| 12. | *Acres sprayed per hour - all flight time1/ | 73.2 | 51.1 | 55.3 | 55.9 | 48.3 | 53.4 |
| 13. | Average spray time per actual flying workday1/ | 2.66 | 2.90 | 2.27 | 3.50 | 3.45 | 2.96 |
| 14. | Acres sprayed per day - all available workdays1/ | 140.2 | 132.8 | 105.6 | 153.0 | 152.1 | 136.7 |
| 15. | Acres sprayed per day - days actual spraying done1/ | 229.7 | 169.3 | 140.8 | 219.0 | 191.1 | 190.0 |
| 16. | Flight hours, survey and other | 11.9 | 18.5 | 40.5 | 0 | 22.9 | 93.8 |
| 17. | Total BRC helicopter use - hours | 158.4 | 582.5 | 525.8 | 136.9 | 577.3 | 1,980.9 |

All spraying on the Clearwater N.F. was done with Hiller 12-E helicopters. Other Forests used Bell Models G-3, G-3B, or G-3B1.

1/ Per one helicopter.

*Does not include 1963 survey or mapping time that was done for the benefit of future spraying or other reasons.

Table 3.--Per Acre Cost Summary of 1963 Aerial (Helicopter) Spraying

| Item | Forest | | | | | Total average |
|---|---|---|---|---|---|---|
| | Clearwater | Coeur d'Alene | Kaniksu | Kootenai | St. Joe | |
| Acres sprayed | 10,490 | 28,820 | 26,860 | 7,650 | 26,780 | 100,600 |
| Phytoactin | $7.02 | $7.48 | $7.11 | $7.29 | $7.03 | $7.19 |
| Helicopter time | 1.70 | 2.25 | 2.42 | 1.76 | 2.08 | 2.04 |
| Salaries (all spray projects) | .82 | .39 | .48 | .46 | .31 | .49 |
| Meal subsidy and per diem | .17 | .08 | .11 | .12 | .07 | .11 |
| Fuel oil | .22 | .25 | .21 | .26 | .24 | .24 |
| Multi-Film L and $NAHSO_4$ and other spraying materials, supplies | .04 | .04 | .04 | .05 | .02 | .04 |
| Helispot construction | .11 | .24 | .17 | .24 | .01 | .15 |
| Roads and plowing snow | .10 | .03 | .03 | .00 | .00 | .03 |
| Other - equipment use, camp construction, trailers, etc. | .25 | .11 | .11 | .16 | .20 | .17 |
| Totals - Cost per acre | $10.43 | $10.87 | $10.68 | $10.34 | $9.96 | $10.46 |

Cost of all aerial survey and mapping work done as part of the actual spray job is included. Other flying time used for surveying and mapping in preparation of future treatment plans is not included.

## VI. STATISTICAL TABLES

Statistical tables summarizing accomplishments and expenditures on a calendar year basis for each program and a total of all programs is presented in this section.

An explanation of the tables for the total of all programs follows. The tables for individual programs are similar.

1. Blister Rust Control Expenditures.

   All funds expended in Region 1 including research reimbursement items for developmental work.

2. Field Organization.

   Self-explanatory.

3. Total Progress of Ribes Eradication.

   All areas worked either initially or reworked are included. The area in Table 4 and all work done with Sale Area Betterment (K-V) funds is included.

4. Chemical Eradication.

   This table shows the acres sprayed with 2,4,5-T herbicides to eradicate ribes. The application may be from truck-mounted or backpack sprayers. These data are included in Table 3.

5. Antibiotic Treatment.

   The number of trees treated are determined from random sample plot counts.

6. Surveys.

   a. Type - Ribes. Includes all types of checking, disease surveys, and pre-eradication surveys done for the purpose of ribes eradication.

   b. Type - Antibiotic. Includes all types of survey work done for the purpose of determining areas to be treated with antibiotics. Flying time directly connected with actual spraying is not included. Systematic inspection of treated areas to determine effectiveness is also included.

7. Net Acres of White Pine by Age Classes.

   This table includes all areas satisfactorily stocked with white pine. The areas reported for the National Forest, and the State and Private programs have 20 percent or more white pine stocking. All areas that have been approved for white pine management and those areas where the present stand can be brought through to maturity with the application of antibiotics alone and without ribes eradication are included

Areas of white pine sites presently unsatisfactorily stocked or protection zones are not included. The data reported for the National Forest program include only National Forest and Public Domain land. The data reported for the State and Private program include only State and Private lands.

8. Accumulative Summary of Antibiotic Treatment.

This table shows the breakdown between the presently approved white pine management units and the areas planned for antibiotic treatment only. Areas outside of the approved units warranting immediate antibiotic treatment are now being treated on a priority basis.

9. Ownership in Blister Rust Control Programs.

The area shown as National Forest program includes only National Forest and Public Domain lands. Only state and private land is included in the State and Private program. Intermingled lands have been separated and are reported in the respective programs on the basis of ownership.

White pine management units are those areas that have been approved for the continuous production of western white pine. They are the highest priority units based on volume productivity with ribes eradication that were established following the 1948 and 1949 unit analysis. Additional ribes eradication work will be necessary. Antibiotic treatment will be done where and when necessary.

Areas outside are those established stands outside of approved white pine management units that, by treating existing stocking with antibiotics, could be brought through to a merchantable size. The next crop on these lands will depend on developments in rust-resistant pine, antibiotics and economic changes.

## SUMMARY OF ALL PROGRAMS

1. Blister Rust Control Expenditures, Calendar Year 1963

| State | U.S. Forest Service, Region 1 | | | | | National Park Service | State and Private | Total |
|---|---|---|---|---|---|---|---|---|
| | 042 | 720 | 411 | K-V | Total | | | |
| Idaho | 1,496,552 | 27,936 | 102,498 | 194,233 | 1,821,219 | | 102,075 | 1,923,294 |
| Mont. | 154,987 | | | 2,700 | 157,687 | 86,178 | | 243,865 |
| Wash. | 131,487 | | | 10,344 | 141,831 | | | 141,831 |
| Colo. | | | | | | 23,155 | | 23,155 |
| Wyo. | 870 | | | | 870 | 106,242 | | 107,112 |
| Total | 1,783,896 | 27,936 | 102,498 | 207,277 | 2,121,607 | 215,575 | 102,075 | 2,439,257 |

This table includes all Regional Office and Development and Improvement Expenditures

042 - Federal funds for National Forest program.
720 - Leadership and technical direction on non-Federal lands.
411 - Federal matching funds for State and Private cooperative programs.
K-V - Stand improvement collections used for BRC on National Forest lands.

2. Field Organization - 1963

| Program | Camps | Employees ribes eradication | Employees antibiotic treatment | Total employees |
|---|---|---|---|---|
| National Forest | 16 | 201 | 163 | 364 |
| National Park | 5 | 81 | 46 | 127 |
| State & Private | 5 | 40 | 100 | 140 |
| All programs | 26 | 322 | 309 | 631 |

3. Total Progress of Ribes Eradication - 1963

| Ownership | Acres | Man-days | Ribes | Per acre | |
|---|---|---|---|---|---|
| | | | | Man-days | Ribes |
| National Forest | 8,120 | 7,818 | 2,163,000 | .96 | 266 |
| National Park | 14,090 | 3,900 | 434,000 | .28 | 31 |
| State & Private | 1,950 | 1,803 | 111,400 | .92 | 57 |
| Total | 24,160 | 13,521 | 2,708,400 | .56 | 112 |

SUMMARY OF ALL PROGRAMS

4. Chemical Eradication - 1963

| Ownership | Acres | Man-days | Ribes destroyed | Gallons of spray solution | Man-days per acre |
|---|---|---|---|---|---|
| National Forest | 920 | 1,400 | 1,256,200 | 200,420 | 1.52 |
| National Park | 360 | 1,280 | 264,000 | 34,540 | 3.56 |
| State & Private | 60 | 30 | 1,600 | 3,200 | .50 |
| Total | 1,340 | 2,710 | 1,521,800 | 238,160 | 2.02 |

5. Antibiotic Treatment - 1963

| Ownership | Method | Acres treated | Trees treated | Gallons solution | Man-days | Helicopter hours |
|---|---|---|---|---|---|---|
| National Forest | Hand | 7,440 | 1,076,400 | 77,060 | 5,211 | |
| | Aerial | 96,630 | 14,806,220 | 723,050 | 1,906 | 1,808.5 |
| | Total | 104,070 | 15,882,620 | 800,110 | 7,117 | 1,808.5 |
| National Park | Hand | 3,790 | 362,000 | 9,060 | 1,320 | |
| State & Private | Hand | 3,910 | 593,180 | 24,260 | 2,458 | |
| | Aerial | 3,970 | 372,010 | 28,790 | 93 | 79.6 |
| | Total | 7,880 | 965,190 | 53,050 | 2,551 | 79.6 |
| All | Hand | 15,140 | 2,031,580 | 110,380 | 8,989 | |
| | Aerial | 100,600 | 15,178,230 | 751,840 | 1,999 | 1,888.1 |
| | Total | 115,740 | 17,209,810 | 862,220 | 10,988 | 1,888.1 |

6. Surveys - 1963

| Ownership | Type | Acres | Man-days | Helicopter hours |
|---|---|---|---|---|
| National Forest | Ribes | 9,450 | 217 | |
| | Antibiotic | 277,240 | 1,213 | 61.5 |
| | Total | 286,690 | 1,430 | 61.5 |
| National Park | Ribes | 60,930 | 400 | |
| | Antibiotic | 1,230 | 10 | |
| | Total | 62,160 | 410 | |
| State & Private | Ribes | 1,520 | 32 | |
| | Antibiotic | 78,910 | 288 | 31.3 |
| | Total | 80,430 | 320 | 31.3 |
| Total | Ribes | 71,900 | 649 | |
| | Antibiotic | 357,380 | 1,511 | |
| | Total | 429,280 | 2,160 | 92.8 |

## SUMMARY OF ALL PROGRAMS

7. Net Acres of White Pine by Age Classes - 1963

| Ownership | Age classes by date of origin | | | | | | Total acres |
|---|---|---|---|---|---|---|---|
| | 1980-1961 | 1960-1941 | 1940-1921 | 1920-1881 | 1880-1841 | 1840 & prior | |
| National Forest | 10,590 | 27,330 | 254,530 | 445,330 | 111,310 | 423,120 | 1,272,210 |
| National Park | - - - - - - - - Not classified - - - - - - - - | | | | | | 101,800 |
| State & Private | 2,180 | 45,600 | 114,730 | 187,480 | 30,450 | 164,710 | 545,150 |
| Total | 12,770 | 72,930 | 369,260 | 632,810 | 141,760 | 587,830 | 1,919,160 |

8. Accumulative Summary of Antibiotic Treatment - 1963

| Ownership | Within white pine management units | | Areas outside of white pine management units | | All areas | |
|---|---|---|---|---|---|---|
| | Total acres | Acres treated to date | Total acres | Acres treated to date | Total acres | Acres treated to date |
| National Forest | 494,480 | 187,520 | 777,730 | 82,380 | 1,272,210 | 269,900 |
| National Park | 93,910 | 3,580 | 7,890 | 7,060 | 101,800 | 10,640 |
| State & Private | 167,440 | 36,000 | 377,710 | 8,270 | 545,150 | 44,270 |
| Totals | 755,830 | 227,100 | 1,163,330 | 97,710 | 1,919,160 | 324,810 |

9. Ownership of Areas in Blister Rust Control Program - 1963

| | National Forest | Public Domain | National Park | State | Private | Total |
|---|---|---|---|---|---|---|
| White pine stocked | 1,253,150 | 19,060 | 101,800 | 169,940 | 375,210 | 1,919,160 |
| Protection zone areas | 172,480 | 3,500 | | 22,070 | 52,260 | 250,310 |
| Total | 1,425,630 | 22,560 | 101,800 | 192,010 | 427,470 | 2,169,470 |

## FEDERAL LANDS

1. Forest Expenditures, Calendar Year 1963

| Forest | 042 funds | K-V funds | Total |
|---|---|---|---|
| Clearwater | 242,469 | 141,692 | 384,161 |
| Coeur d'Alene | 462,736* | 19,819 | 482,555 |
| Colville** | 37,000 | | 37,000 |
| Kaniksu | 422,976 | 43,066 | 466,042 |
| Kootenai | 106,158* | 2,700 | 108,858 |
| St. Joe | 360,966 | | 360,966 |
| Total | 1,632,305 | 207,277 | 1,839,582 |

*Includes 720 funds.

**Kaniksu National Forest administers the program on the Colville National Forest.

2. Field Organization - 1963

| Forest | Camps | Employees ribes eradication | Employees antibiotic treatment | Total employees |
|---|---|---|---|---|
| Clearwater | 5 | 135 | 5 | 140 |
| Coeur d'Alene | 4 | 50 | 30 | 80 |
| Colville | 1 | 0 | 10 | 10 |
| Kaniksu | 3 | 16 | 54 | 70 |
| Kootenai | 1 | 0 | 14 | 14 |
| St. Joe | 2 | 0 | 50 | 50 |
| All Forests | 16 | 201 | 163 | 364 |

3. Total Progress of Ribes Eradication - 1963

| Forest | Acres | Man-days | Ribes | Per acre | |
|---|---|---|---|---|---|
| | | | | Man-days | Ribes |
| Clearwater | 4,610 | 5,068 | 733,400 | 1.10 | 159 |
| Coeur d'Alene | 1,760 | 1,900 | 627,000 | 1.08 | 356 |
| Kaniksu | 1,700 | 820 | 801,100 | .48 | 471 |
| St. Joe | 50 | 30 | 1,500 | .60 | 30 |
| All Forests | 8,120 | 7,818 | 2,163,000 | .96 | 266 |

FEDERAL LANDS

4. Chemical Eradication - 1963

| Forest | Acres | Man-days | Ribes destroyed | Gallons of spray solution | Man-days per acre |
|---|---|---|---|---|---|
| Clearwater | 470 | 700 | 415,200 | 106,570 | 1.49 |
| Coeur d'Alene | 380 | 590 | 444,000 | 77,950 | 1.55 |
| Kaniksu | 70 | 110 | 397,000 | 15,900 | 1.57 |
| All Forests | 920 | 1,400 | 1,256,200 | 200,420 | 1.52 |

5. Antibiotic Treatment - 1963

| Forest | Method | Acres treated | Trees treated | Gallons solution | Man-days | Helicopter hours |
|---|---|---|---|---|---|---|
| Clearwater | Hand | 50 | 11,320 | 930 | 81 | |
| | Aerial | 9,150 | 749,020 | 68,210 | 261 | 126.8 |
| | Total | 9,200 | 760,340 | 69,140 | 342 | 126.8 |
| Coeur d'Alene | Hand | 800 | 160,600 | 8,060 | 730 | |
| | Aerial | 28,820 | 7,202,500 | 222,820 | 510 | 564.0 |
| | Total | 29,620 | 7,363,100 | 230,880 | 1,240 | 564.0 |
| Colville | Hand | 540 | 91,000 | 9,600 | 490 | |
| Kaniksu | Hand | 1,450 | 337,000 | 26,800 | 1,510 | |
| | Aerial | 26,560 | 4,205,000 | 195,200 | 530 | 476.4 |
| | Total | 28,010 | 4,542,000 | 222,000 | 2,040 | 476.4 |
| Kootenai | Hand | 400 | 75,180 | 3,950 | 415 | |
| | Aerial | 7,650 | 1,058,000 | 57,370 | 180 | 136.9 |
| | Total | 8,050 | 1,133,180 | 61,320 | 595 | 136.9 |
| St. Joe | Hand | 4,200 | 401,300 | 27,720 | 1,985 | |
| | Aerial | 24,450 | 1,591,700 | 179,450 | 425 | 504.4 |
| | Total | 28,650 | 1,993,000 | 207,170 | 2,410 | 504.4 |
| All Forests | Hand | 7,440 | 1,076,400 | 77,060 | 5,211 | |
| | Aerial | 96,630 | 14,806,220 | 723,050 | 1,906 | 1,808.5 |
| | Total | 104,070 | 15,882,620 | 800,110 | 7,117 | 1,808.5 |

6. K-V Work - 1963

| Forest | Ribes eradication | | Antibiotic treatment | | Total | |
|---|---|---|---|---|---|---|
| | Acres | Man-days | Acres | Man-days | Acres | Man-days |
| Clearwater | 9,220 | 4,917 | 50 | 81 | 9,270 | 4,998 |
| Coeur d'Alene | 1,240 | 670 | | | 1,240 | 670 |
| Kaniksu | 1,280 | 480 | 1/1,300 | 160 | 2,580 | 640 |
| Kootenai | | | 2/250 | 6 | 250 | 6 |
| All Forests | 11,740 | 6,067 | 1,600 | 247 | 13,340 | 6,314 |

This table includes survey acres.

1/ Includes 1,230 acres of aerial spray (21.7 helicopter hours).
2/ All aerial spray (4.0 helicopter hours).

7. Surveys - 1963

| Forest | Type | Acres | Man-days | Helicopter hours |
|---|---|---|---|---|
| Clearwater | Ribes | 5,520 | 102 | |
| | Antibiotic | 39,400 | 128 | 9.0 |
| | Total | 44,920 | 230 | 9.0 |
| Coeur d'Alene | Ribes | 3,100 | 90 | |
| | Antibiotic | 85,000 | 430 | 14.5 |
| | Total | 88,100 | 520 | 14.5 |
| Colville | Antibiotic | 9,510 | 30 | 0.0 |
| Kaniksu | Ribes | 430 | 20 | |
| | Antibiotic | 88,170 | 270 | 27.1 |
| | Total | 88,600 | 290 | 27.1 |
| Kootenai | Antibiotic | 9,660 | 50 | 0.0 |
| St. Joe | Ribes | 400 | 5 | |
| | Antibiotic | 49,500 | 305 | 10.9 |
| | Total | 49,900 | 310 | 10.9 |
| All Forests | Ribes | 9,450 | 217 | |
| | Antibiotic | 277,240 | 1,213 | 61.5 |
| | Total | 286,690 | 1,430 | 61.5 |

FEDERAL LANDS

8. Net Acres of White Pine by Age Classes - 1963

| Forest | Age classes by date of origin | | | | | | Total acres |
|---|---|---|---|---|---|---|---|
| | 1980-1961 | 1960-1941 | 1940-1921 | 1920-1881 | 1880-1841 | 1840 & prior | |
| Clearwater | 9,470 | 16,270 | 28,910 | 49,880 | 12,370 | 156,530 | 273,430 |
| Coeur d'Alene | 380 | 7,790 | 77,020 | 144,620 | 11,690 | 190,090 | 431,590 |
| Colville | | | 8,960 | 12,490 | 8,680 | 8,420 | 38,550 |
| Kaniksu | 670 | 1,300 | 75,740 | 151,070 | 63,670 | 47,680 | 340,130 |
| Kootenai | 70 | 1,170 | 2,600 | 33,370 | | | 37,210 |
| St. Joe | | 800 | 61,300 | 53,900 | 14,900 | 20,400 | 151,300 |
| All Forests[1/] | 10,590 | 27,330 | 254,530 | 445,330 | 111,310 | 423,120 | 1,272,210 |

1/ Includes 19,060 acres of Public Domain lands.

9. Accumulative Summary of Antibiotic Treatment - 1963

| Forest | State | Areas within white pine management units | | Areas outside of white pine management units | | Total | |
|---|---|---|---|---|---|---|---|
| | | Total acres | Acres treated to date | Total acres | Acres treated to date | Total acres | Acres treated to date |
| Clearwater | Idaho | 162,550 | 34,180 | 110,880 | 1,570 | 273,430 | 35,750 |
| Coeur d'Alene | Idaho | 105,290 | 35,690 | 301,600 | 22,590 | 406,890 | 58,280 |
| | Montana | 5,760 | 1,230 | 18,940 | 1,990 | 24,700 | 3,220 |
| | Total | 111,050 | 36,920 | 320,540 | 24,580 | 431,590 | 61,500 |
| Colville | Wash. | 6,920 | 1,550 | 31,630 | 5,330 | 38,550 | 6,880 |
| Kaniksu | Idaho | 83,870 | 31,000 | 146,810 | 9,360 | 230,680 | 40,360 |
| | Montana | 9,180 | 6,320 | 24,480 | 3,190 | 33,660 | 9,510 |
| | Wash. | 27,400 | 10,860 | 48,390 | 3,280 | 75,790 | 14,140 |
| | Total | 120,450 | 48,180 | 219,680 | 15,830 | 340,130 | 64,010 |
| Kootenai | Idaho | 2,640 | 540 | 300 | 10 | 2,940 | 550 |
| | Montana | 19,370 | 6,970 | 14,900 | 7,820 | 34,270 | 14,790 |
| | Total | 22,010 | 7,510 | 15,200 | 7,830 | 37,210 | 15,340 |
| St. Joe | Idaho | 71,500 | 59,180 | 79,800 | 27,240 | 151,300 | 86,420 |
| Totals | Idaho | 425,850 | 160,590 | 639,390 | 60,770 | 1,065,240 | 221,360 |
| | Montana | 34,310 | 14,520 | 58,320 | 13,000 | 92,630 | 27,520 |
| | Wash. | 34,320 | 12,410 | 80,020 | 8,610 | 114,340 | 21,020 |
| Grand Total | | 494,480 | 187,520 | 777,730 | 82,380 | 1,272,210 | 269,900 |

## STATE AND PRIVATE LANDS

1. Forest Expenditures, Calendar Year 1963

| Forest | Federal funds | | | State and private funds | | | Total all funds |
|---|---|---|---|---|---|---|---|
| | 720 | 411 | Total | State | Private | Total | |
| Clearwater | 5,430 | 39,820 | 45,250 | 27,947 | 10,561 | 38,508 | 83,758 |
| Kaniksu | 3,338 | 1,156 | 4,494 | 13,957 | | 13,957 | 18,451 |
| St. Joe | 1,346 | 57,269 | 58,615 | 36,050 | 9,560 | 45,610 | 104,225 |
| Total | 10,114 | 98,245 | 108,359 | 77,954 | 20,121 | 98,075 | 206,434 |

2. Field Organization - 1963

| Forest | Camps | Employees ribes eradication | Employees antibiotic treatment | Total employees |
|---|---|---|---|---|
| Clearwater | 2 | | 60 | 60 |
| Kaniksu | 1 | | 10 | 10 |
| St. Joe | 2 | 40 | 30 | 70 |
| All Forests | 5 | 40 | 100 | 140 |

3. Total Progress of Ribes Eradication - 1963

| Forest | Acres | Man-days | Ribes | Per acre | |
|---|---|---|---|---|---|
| | | | | Man-days | Ribes |
| Clearwater | 100 | 63 | 21,800 | .63 | 22 |
| St. Joe | 1,850 | 1,740 | 89,600 | .94 | 48 |
| All Forests | 1,950 | 1,803 | 111,400 | .92 | 57 |

4. Chemical Eradication - 1963

| Forest | Acres | Man-days | Ribes destroyed | Gallons of spray solution | Man-days per acre |
|---|---|---|---|---|---|
| Clearwater | 60 | 30 | 1,600 | 3,200 | .50 |

STATE AND PRIVATE LANDS

5. Antibiotic Treatment - 1963

| Area | Forest | Method | Acres treated | Trees treated | Gallons solution | Man-days | Helicopter hours |
|---|---|---|---|---|---|---|---|
| Within Association | Clearwater | Hand | 1,910 | 415,280 | 11,340 | 1,569 | |
| | | Aerial | 710 | 56,910 | 5,150 | 21 | 10.4 |
| | | Total | 2,620 | 472,190 | 16,490 | 1,590 | 10.4 |
| | Kaniksu | Hand | 510 | 18,000 | 2,800 | 110 | |
| | | Aerial | 300 | 67,000 | 2,200 | 10 | 8.9 |
| | | Total | 810 | 85,000 | 5,000 | 120 | 8.9 |
| | St. Joe | Hand | 1,080 | 109,000 | 8,270 | 625 | |
| | | Aerial | 30 | 3,000 | 230 | 1 | 1.0 |
| | | Total | 1,110 | 112,000 | 8,500 | 626 | 1.0 |
| | Total | Hand | 3,500 | 542,280 | 22,410 | 2,304 | |
| | | Aerial | 1,040 | 126,910 | 7,580 | 32 | 20.3 |
| | | Total | 4,540 | 669,190 | 29,990 | 2,336 | 20.3 |
| Outside Association | Clearwater | Aerial | 630 | 47,700 | 4,620 | 20 | 10.3 |
| | St. Joe | Hand | 410 | 50,900 | 1,850 | 154 | |
| | | Aerial | 2,300 | 197,400 | 16,590 | 41 | 49.0 |
| | | Total | 2,710 | 248,300 | 18,440 | 195 | 49.0 |
| | Total | Hand | 410 | 50,900 | 1,850 | 154 | |
| | | Aerial | 2,930 | 245,100 | 21,210 | 61 | 59.3 |
| | | Total | 3,340 | 296,000 | 23,060 | 215 | 59.3 |
| All Forests | Total | Hand | 3,910 | 593,180 | 24,260 | 2,458 | |
| | | Aerial | 3,970 | 372,010 | 28,790 | 93 | 79.6 |
| | | Total | 7,880 | 965,190 | 53,050 | 2,551 | 79.6 |

## STATE AND PRIVATE LANDS

6. Surveys - 1963

| Forest | Type | Acres | Man-days | Helicopter hours |
|---|---|---|---|---|
| Clearwater | Antibiotic | 16,160 | 148 | 1.9 |
| Coeur d'Alene | Antibiotic | 5,500 | 10 | 4.0 |
| Kaniksu | Antibiotic | 14,300 | 30 | 13.4 |
| St. Joe | Antibiotic<br>Ribes | 42,950<br>1,520 | 100<br>32 | 12.0 |
| All Forests | | 80,430 | 320 | 31.3 |

7. Net Acres of White Pine by Age Classes - 1963

| Forest | Age classes by date of origin | | | | | | Total acres |
|---|---|---|---|---|---|---|---|
| | 1980-1961 | 1960-1941 | 1940-1921 | 1920-1881 | 1880-1841 | 1840 & prior | |
| Clearwater | 1,580 | 38,380 | 46,290 | 18,560 | 11,350 | 49,470 | 165,630 |
| Coeur d'Alene | | 460 | 8,150 | 31,140 | 2,020 | 21,670 | 63,440 |
| Colville | | | | 7,450 | | | 7,450 |
| Kaniksu | | 960 | 31,090 | 89,230 | 11,880 | 12,070 | 145,230 |
| St. Joe | 600 | 5,800 | 29,200 | 41,100 | 5,200 | 81,500 | 163,400 |
| All Forests | 2,180 | 45,600 | 114,730 | 187,480 | 30,450 | 164,710 | 545,150 |

STATE AND PRIVATE LANDS

8. Accumulative Summary of Antibiotic Treatment - 1963

| Forest | Ownership and state | Areas within white pine management units | | Areas outside white pine management units | | Total | |
|---|---|---|---|---|---|---|---|
| | | Total acres | Acres treated to date | Total acres | Acres treated to date | Total acres | Acres treated to date |
| Clearwater | Idaho | | | | | | |
| | State | 16,840 | 3,610 | 33,050 | 780 | 49,890 | 4,390 |
| | Private | 54,000 | 9,020 | 61,740 | 920 | 115,740 | 9,940 |
| | Forest total | 70,840 | 12,630 | 94,790 | 1,700 | 165,630 | 14,330 |
| Coeur d'Alene | Idaho | | | | | | |
| | State | 1,010 | 220 | 13,620 | | 14,630 | 220 |
| | Private | 1,450 | | 45,390 | | 46,840 | |
| | Total | 2,460 | 220 | 59,010 | | 61,470 | 220 |
| | Montana | | | | | | |
| | Private-all | 1,060 | | 910 | | 1,970 | |
| | All states | | | | | | |
| | State | 1,010 | 220 | 13,620 | | 14,630 | 220 |
| | Private | 2,510 | | 46,300 | | 48,810 | |
| | Forest total | 3,520 | 220 | 59,920 | | 63,440 | 220 |
| Colville | Washington | | | | | | |
| | State | 710 | | | | 710 | |
| | Private | 880 | | 5,860 | | 6,740 | |
| | Forest total | 1,590 | | 5,860 | | 7,450 | |
| Kaniksu | Idaho | | | | | | |
| | State | 25,280 | 4,400 | 20,260 | 2,840 | 45,540 | 7,240 |
| | Private | 12,710 | 50 | 40,270 | 30 | 52,980 | 80 |
| | Total | 37,990 | 4,450 | 60,530 | 2,870 | 98,520 | 7,320 |
| | Montana | | | | | | |
| | State | 640 | | 40 | | 680 | |
| | Private | 1,960 | | 5,540 | | 7,500 | |
| | Total | 2,600 | | 5,580 | | 8,180 | |
| | Washington | | | | | | |
| | State | 120 | | 4,970 | | 5,090 | |
| | Private | 2,180 | | 31,260 | | 33,440 | |
| | Total | 2,300 | | 36,230 | | 38,530 | |
| | All states | | | | | | |
| | State | 26,040 | 4,400 | 25,270 | 2,840 | 51,310 | 7,240 |
| | Private | 16,850 | 50 | 77,070 | 30 | 93,920 | 80 |
| | Forest total | 42,890 | 4,450 | 102,340 | 2,870 | 145,230 | 7,320 |

STATE AND PRIVATE LANDS

8. Accumulative Summary of Antibiotic Treatment - 1963 (Con.)

| Forest | Ownership and state | Areas within white pine management units | | Areas outside white pine management units | | Total | |
|---|---|---|---|---|---|---|---|
| | | Total acres | Acres treated to date | Total acres | Acres treated to date | Total acres | Acres treated to date |
| | Idaho | | | | | | |
| | State | 18,600 | 13,900 | 34,800 | 2,720 | 53,400 | 16,620 |
| St. Joe | Private | 30,000 | 4,800 | 80,000 | 980 | 110,000 | 5,780 |
| | Forest total | 48,600 | 18,700 | 114,800 | 3,700 | 163,400 | 22,400 |
| | Idaho | | | | | | |
| | State | 61,730 | 22,130 | 101,730 | 6,340 | 163,460 | 28,470 |
| | Private | 98,160 | 13,870 | 227,400 | 1,930 | 325,560 | 15,800 |
| | Total | 159,890 | 36,000 | 329,130 | 8,270 | 489,020 | 44,270 |
| | Montana | | | | | | |
| | State | 640 | | 40 | | 680 | |
| | Private | 3,020 | | 6,450 | | 9,470 | |
| | Total | 3,660 | | 6,490 | | 10,150 | |
| Grand Totals | Washington | | | | | | |
| | State | 830 | | 4,970 | | 5,800 | |
| | Private | 3,060 | | 37,120 | | 40,180 | |
| | Total | 3,890 | | 42,090 | | 45,980 | |
| | All states | | | | | | |
| | State | 63,200 | 22,130 | 106,740 | 6,340 | 169,940 | 28,470 |
| | Private | 104,240 | 13,870 | 270,970 | 1,930 | 375,210 | 15,800 |
| | Total | 167,440 | 36,000 | 377,710 | 8,270 | 545,150 | 44,270 |

# NATIONAL PARKS PROGRAM

1. Expenditures - Calendar Year 1963

| National Park | State | National Park funds | National Forest funds | Total all funds |
|---|---|---|---|---|
| Glacier | Montana | 86,178 | 2,610 | 88,788 |
| Grand Teton | Wyoming | 163 | | 163 |
| Rocky Mountain | Colorado | 23,155 | | 23,155 |
| Yellowstone | Wyoming | 106,079 | 870 | 106,949 |
| All Parks | | 215,575 | 3,480 | 219,055 |

2. Field Organization - 1963

| National Park | Camps | Employees ribes eradication | Employees antibiotic treatment | Total employees |
|---|---|---|---|---|
| Glacier | 2 | | 46 | 46 |
| Rocky Mountain | 1 | 16 | | 16 |
| Yellowstone | 2 | 65 | | 65 |
| All Parks | 5 | 81 | 46 | 127 |

3. Total Progress Ribes Eradication - 1963

| National Park | Acres | Man-days | Ribes | Per acre | |
|---|---|---|---|---|---|
| | | | | Man-days | Ribes |
| Rocky Mountain | 1,060 | 820 | 155,000 | .77 | 146 |
| Yellowstone | 13,030 | 3,080 | 279,000 | .24 | 22 |
| All Parks | 14,090 | 3,900 | 434,000 | .28 | 31 |

4. Chemical Eradication - 1963

| National Park | Acres | Man-days | Ribes destroyed | Gallons of spray solution | Man-days per acre |
|---|---|---|---|---|---|
| Rocky Mountain | 140 | 550 | 138,000 | 16,540 | 3.93 |
| Yellowstone | 220 | 730 | 126,000 | 18,000 | 3.32 |
| All Parks | 360 | 1,280 | 264,000 | 34,540 | 3.56 |

5. Antibiotic Treatment - 1963

| National Park | Method | Acres treated | Trees treated | Gallons solution | Man-days | Man-days per acre |
|---|---|---|---|---|---|---|
| Glacier | Hand | 3,790 | 362,000 | 9,060 | 1,320 | .35 |

6. Surveys - 1963

| National Park | Type | Acres | Man-days |
|---|---|---|---|
| Glacier | Antibiotic<br>Ribes | 1,230<br>970 | 10<br>30 |
| Rocky Mountain | Ribes | 580 | 30 |
| Yellowstone | Ribes | 59,380 | 340 |
| All Parks | | 62,160 | 410 |

7. Control Status - 1963

| National Park | Total acres | Unworked areas | Worked area | |
|---|---|---|---|---|
| | | | Needing rework acres | On maintenance acres |
| Glacier | 6,010 | | 1,820 | 4,190 |
| Grand Teton | 1,010 | | 100 | 910 |
| Rocky Mountain | 12,650 | 2,990 | 1,060 | 8,600 |
| Yellowstone | 74,240 | 26,220 | 8,940 | 39,080 |
| All Parks | 93,910 | 29,210 | 11,920 | 52,780 |

8. Accumulative Summary of Antibiotic Treatment - 1963

| National Park | Acres within ribes eradication units | | Acres outside ribes eradication units | | Total | |
|---|---|---|---|---|---|---|
| | Total acres | Acres treated to date | Total acres | Acres treated to date | Total acres | Acres treated to date |
| Glacier | 6,010 | 3,580 | 7,890 | 7,060 | 13,900 | 10,640 |
| Grand Teton | 1,010 | | | | 1,010 | |
| Rocky Mountain | 12,650 | | | | 12,650 | |
| Yellowstone | 74,240 | | | | 74,240 | |
| All Parks | 93,910 | 3,580 | 7,890 | 7,060 | 101,800 | 10,640* |

*Glacier National Park has an antibiotic treatment program. All other Parks are on a ribes eradication protection program only.